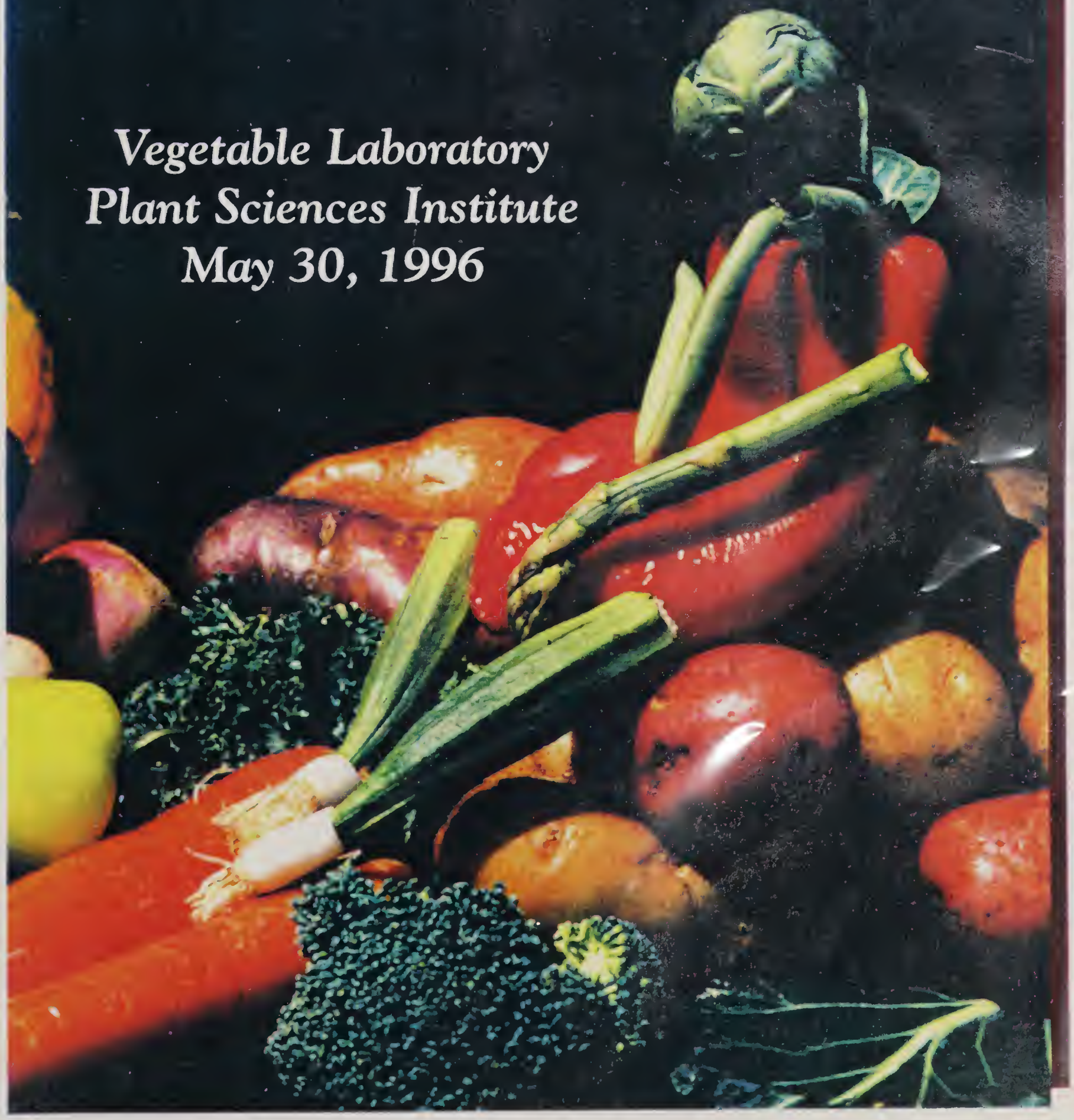
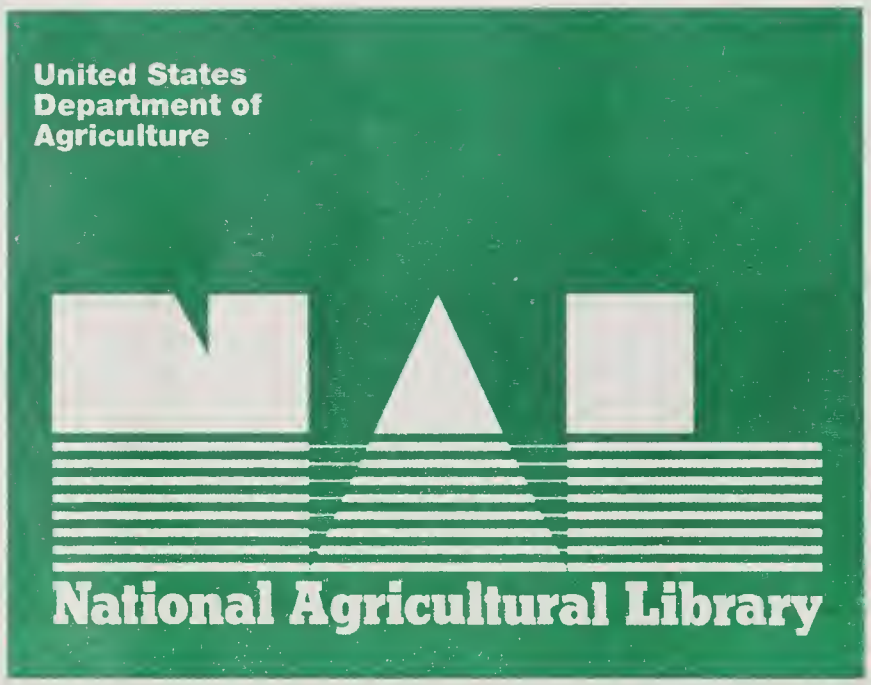
# Beltsville Area Laboratory Review

## Vegetable Laboratory
## Plant Sciences Institute
## May 30, 1996




United States
Department of
Agriculture
National Agricultural Library

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# AGENDA

BRIEF LABORATORY REVIEW
VEGETABLE LABORATORY
BUILDING 010A, CONFERENCE ROOM
MAY 30, 1996

## INTRODUCTION

| | | |
|---|---|---|
| 8:30 | Opening Remarks | Ronald F. Korcak, Acting<br>Associate Institute Director |
| 8:40 | State of the Management Unit | Kenneth L. Deahl, Acting Research Leader<br>Vegetable Laboratory |

## RESEARCH PROGRESS AND PLANS

9:00 William W. Cantelo, Research Entomologist

9:15 John R. Stommel, Research Geneticist

9:30 Aref A. Abdul-Baki, Research Plant Physiologist

9:45 Kenneth L. Deahl, Research Plant Pathologist

10:00 Break

10:15 Robert W. Goth, Research Plant Pathologist

10:30 Kathleen G. Haynes, Research Plant Geneticist

10:45 Lind L. Sanford, Research Plant Geneticist

11:00 Robert F. Whitcomb, Research Entomologist

11:15 Summary and Discussion

11:30 Executive Session and Summary

# PARTICIPANTS

**ADMINISTRATIVE**

Jan van Schilfgaarde, Acting Director
Beltsville Area

Joseph Spence, Acting Associate Director
Beltsville Area

**PLANT SCIENCES INSTITUTE STAFF**

Barbara A. Leonhardt
Institute Director

Ronald F. Korcak, Acting
Associate Institute Director

**NATIONAL PROGRAM STAFF**

Judith B. St. John
ADA
Plant Sciences

Henry L. Shands
ADA
Genetic Resources

Roger H. Lawson
National Program Leader
Horticulture and Sugar Crops

Roy Gingery
National Program Leader
Plant Health

Robert M. Faust
National Program Leader
Fundamental and Molecular Entomology

# MISSION STATEMENTS

## RESEARCH, EDUCATION AND ECONOMICS, USDA

The mission of Research, Education, and Economics is to create, apply and transfer knowledge and technology to provide affordable food and fiber, ensure food safety and nutrition, protect the environment and support the rural development and natural resource needs of people by conducting integrated national and international research, information, education, economic, and statistical programs and services that are in the national interest.

## AGRICULTURAL RESEARCH SERVICE

The mission of the Agricultural Research Service is to develop new knowledge and technology needed to solve technical agricultural problems of broad scope and high national priority in order to ensure adequate production of high-quality food and agricultural products to meet the nutritional needs of the American consumer, to sustain a viable food and agricultural economy and to maintain a quality environment and natural resource base.

## PLANT SCIENCES INSTITUTE

The Plant Sciences Institute research mission is to develop biological, chemical, and physical processes and principles, including bioregulation, that will improve pest management systems, improve crop production efficiency, improve conservation of natural resources, improve environmental quality, support regulatory and action agencies, and contribute to advances in biotechnology and other societal benefits. The Institute's mission is accomplished through complex and exceptionally difficult fundamental and applied research programs in 16 laboratories.

## VEGETABLE LABORATORY

The mission of the Vegetable Laboratory is to genetically improve the quality and pest resistance of vegetables and develop more efficient production practices. Through traditional breeding and using biotechnology, scientists develop potatoes, tomatoes and other vegetables with superior nutritional quality, disease and insect pest resistance and high consumer acceptability. Scientists also develop production systems that reduce inputs of farm chemicals and production costs.

# RESEARCH ACCOMPLISHMENTS

## POTATO RESEARCH

- Released a Verticillium wilt resistant russett-skinned potato clone, B0169-56, to breeders at the federal, state and industry level in 1993. It is resistant to *Verticillium dahliae* and *V. albo-atrum,* causal organisms in the potato early dying disease complex, a significant disease of potato through out the world.

- Studied the genetic consequences of using diploid parents in tetraploid x diploid crosses with respect to the mode of 2n gamete formation and identified ways to minimize inbreeding.

- Found that additive genetic, non-additive genetic, and genotype x environmental sources of variation to occur in roughly equal proportions in a diploid population which will be an important source of new genetic material for the high specific gravity breeding effort.

- Developed a method to quantitatively score tubers for yellow-flesh intensity and found that the role of genotype x environment interactions on the intensity of yellow-flesh was small.

- Monitored changes in late blight pathogen populations in various potato production areas to aid in the design of anti-resistance strategies since many recently isolated fungicide resistant strains appear to be more fit and aggressive.

- Discovered an alternate host for the late blight disease of potato. Wild *Solanum* species, notably *S. saccachoides* (hairy night shade), were found to be natural reservoirs for pathogenic strains of the fungus.

- Demonstrated that the probable cause of recent genetic changes in populations of *Phytophthora infestans*, the fungus that causes late blight of potato and tomato is due to migration from Mexico. The data provide a baseline for monitoring future genetic changes in populations of the fungus in the United States and Canada.

- Established that fifteen cultivars had sufficient field tolerance corky ringspot disease of potato to provide an economically feasible yield of horticulturally acceptable tubers.

- Established that infection by *Verticillim dahliae* and V. *albo-atrum* enhanced, but was not essential for, the development of pink-eye disease of potato. Determined that there was no consistent relationship between the severity of Verticillium wilt and the incidence of pink-eye in segregating families.

- Established that eleven USDA seedlings are highly resistant to *Pseudomonas solanacearum,* the causal agent of bacterial brown rot.

- Established that two advanced potato clones are resistance to the highly infectious new strains of *Phytophthora infestans,* the causal organism of potato late blight.

- Developed a numerical system based on cluster analysis of scab lesion type and percentage of tuber surface area infected, to quantitatively compare scab reactions of new potato germplasm.

- Two selections from the potato breeding program have entered into the national Snack Food Association Trials every year.

- Developed late blight resistant clones B0718-3 and B0767-2. These are currently being prepared for release.

- Genes for leptine synthesis conferring resistance to Colorado potato beetle were introgressed into Tuberosum germplasm using regenerated tetraploid germplasm from the species *S. chacoense*.

- A possible cause of resistance to potato leafhopper, a widespread pest of potatoes, was identified. Of the two glycoalkaloids commonly found in the commercial potato, chaconine, was considerably more active against leafhoppers than was solanine.

- The genetic control of leptine synthesis in *S. chacoense* appears to be influenced by at least three genes. Understanding its inheritance will aid its introgression into Tuberosum.

**TOMATO/PEPPER RESEARCH**

- Developed and released three ornamental pepper germplasm lines which will be utilized by public and private plant breeders and seedsmen as new cultivars and for use in developing new ornamental pepper cultivars.

- A gene has been identified in tomatoes which regulates the type of sugar accumulated. Scientists are using the new gene to increase sugar content and satisfy changing customer and industry trends in the fresh and processing markets.

- A gene identified in a wild tomato species which increases fruit beta-carotene content approximately 20-fold, together with a gene that increases total fruit pigmentation, is being used to improve the pigmentation and nutritional value of tomato fruit.

- Fertile somatic hybrids have been created between the cultivated tomato and a pest resistant distant relative of tomato, *Solanum ochranthum*. These hybrids will be used to facilitate transfer of genes for insect, bacterial, fungal and viral resistance into tomato.

- Described the importance of the organism *Erwinia carotova* subsp. *atroseptica* in pepper soft rot decay under cool postharvest storage conditions and identified potential genetic sources of resistance.

**SUSTAINABLE AGRICULTURAL SYSTEMS**

- Developed a hairy vetch system as an alternative to plastic mulch for growing vegetables. The hairy vetch mulch adds 5-6 tons of dry matter, provides 180 kg of nitrogen per ha and yields 30-40% higher than the plastic mulch system.

- Determined the nitrogen requirements of fresh-market tomatoes and found that maximum yield is achieved by applying 89 kg/ha when grown in hairy vetch mulch as compared to 190 kg/ha in plastic mulch. A 100 kg reduction in nitrogen requirement per ha significantly lowers the production cost and saves surface and underground water from contamination by nitrates.

- Established by testing a large number of varieties, that the positive responses by vegetables to the hairy vetch mulch, i.e. higher yields and vigorous plants, are exhibited by every tested variety and, therefore, are not genotype dependent.

- Established a system of 30 sustainable meadows as lawn replacements. Species compositions of plants and leafhoppers were determined, and shifts in populations during the establishment period were noted.

**INSECT RESEARCH**

- Analysis of mitochondrial and nuclear genes showed that leafhopper species with linear connectives fused with the aedeagus are monophyletic. Other molecular studies showed that leafhopper host shifts were relatively rare, indicating a low probability of new leafhopper pest evolution.

- A synthetic diet was developed for Colorado potato beetle.

- Using minimum quantities of systemic insecticides to control aphids and leafhoppers, it was possible to control the Colorado potato beetle using crop rotation, releases of the 12-spotted lady beetle, natural populations of parasitic flies, and applications of the bacterial insecticide, M-Trak.

- Leptine, a potent feeding deterrent of Colorado potato beetle, was found to cause no greater leafhopper mortality than solanine, a common glycolalkaloid in the commercial potato species. Chaconine, the other commonly found potato glycoalkaloid, reduced leafhopper survival significantly more than leptine.

- Insect-attacking nematodes (minute eel-worms) were found to have good potential for controlling the Colorado potato beetle.

- Found that foliage leptines in *S. chacoense*, which are potent Colorado potato beetle deterrents, are qualitatively controlled by several genes.

# PRODUCTIVITY SUMMARY (4/93-PRESENT)

| Name of Scientist | Refereed Papers | | "Senior Author" Credit (Total) | Popular Articles/ Abstracts | Scientific Presentations | Germplasm or Varietal Release |
|---|---|---|---|---|---|---|
| | 1st Author | Co-Author | | | | |
| Abdul-Baki, Aref A. | 6 | 3 | 6 | 15 | 16 | 0 |
| Cantelo, William W. | 0 | 3 | 2 | 1 | 1 | 0 |
| Deahl, Kenneth L. | 5 | 7 | 7 | 5 | 15 | 0 |
| Goth, Robert W. | 7 | 4 | 8 | 7 | 12 | 1 |
| Haynes, Kathleen G. | 6 | 8 | 6 | 14 | 7 | 0 |
| Sanford, Lind L. | 4 | 0 | 4 | 0 | 3 | 0 |
| Stommel, John R. | 5 | 3 | 7 | 0 | 0 | 0 |
| Whitcomb, Robert F. | 23 | 13 | 23 | 4 | 5 | 0 |

## TECHNOLOGY TRANSFER ACTIVITIES

- A Trust Fund ($10,000/year- approval pending) has been established with Heinz U.S.A. to develop tomato germplasm with improved quality and pest resistance. This agreement will support ongoing research in the laboratory to investigate genetic resistance to anthracnose in tomato, conduct research to identify molecular markers linked to resistance genes, enhance fruit pigmentation, and introgress genes from wild tomato species for improvement of tomato fruit solids content.

- Several VL scientists collaborate with many international scientists on projects and techniques relating to: development and evaluation of new plant cultivars; utilizing wild species in germplasm enhancement projects; global distribution of certain emerging plant pathogen; migration and displacement of fungal strains and the resulting increased genotypic diversity in pathogen populations.

- Scientists in the VL work with Industry and State scientists and regularly receive input from growers, consumers, and processors (on their needs for research). The VL potato and tomato breeding programs work with State breeders and extension agents in many states, including FL, GA, NC, VA, PA, NJ, NY, OH, MI, WI, MN, TX, CO, WA, ID, OR and ME, and with industry scientists from Borden, Inc., Anheuser-Bush, Campbell Soup, and McCain Foods to improve yield, disease resistance and market quality of tomatoes and potatoes. Ciba-Geigy provides $1,500 per year to investigate the development of fungicide tolerance by the potato late blight pathogen. Hybri-Tech, provides $1,000 per year for cooperative testing of transgenic insect pest resistant potato lines. Scientists regularly attend commodity meetings and receive input on needs for future research and feedback on usefulness of their current and past research.

- Scientists have been contacted by the press, growers, extension personnel, industry, foreign and domestic scientists regarding viral (PLRV, PVY, PVA, PVS, and PVM), fungal (early dying, pink rot, scab), and bacterial pathogens (bacterial brown rot, bacterial soft rot, and bacterial ring rot).

- Technology transferred to farmers for vegetable production in mulch systems was highly rated. The scientist received the Small Farmers' National Award for 1994, the ARS National Award for 1994, and the Federal Laboratories Consortium Award for 1995.

- Scientists cooperated (informally) with and provided industry, e.g., Agdia, Hydros, Nature Mark, Zeneca Ag. Products, with the requested information, methodology, test pathogens, viral antigens, and disease indicator plants used to study potato and other vegetable pathogens.

# IN-HOUSE CRIS SUMMARY

| CRIS # | TITLE | SCIENTIST(S) | FTE | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| 1275-21000-085-00D | Identification and Genetic Enhancement of Pest Resistant Vegetable Germplasm | S. Sinden<br>L. Sanford<br>J. Stommel<br>K. Deahl | 0.40<br>0.30<br>0.10<br>0.10 | $148,089 | 10/01/93 | 09/30/98 |
| 1275-21000-088-00D | Evaluation of Modern Vegetable Crop Managment and Cultivars/Alternative Systems to Maximize Land Use | A. Abdul-Baki | 1.0 | $233,116 | 07/18/94 | 07/17/99 |
| 1275-21000-089-00D | Pest Resistant Vegetable Germplasm Through Tissue Culture | S.Sinden<br>K. Deahl | 0.50<br>0.10 | $168,351 | 08/02/94 | 08/01/99 |
| 1275-21000-106-00D | Multiplication and Evaluation of Potato Breeding Selections | K. Haynes | 0.50 | $212,596 | 01/30/95 | 01/29/00 |
| 1275-21000-109-00D | Breeding Potatoes for Disease and Insect Resistance, Processing, and Fresh Market | K. Haynes<br>L. Sanford | 0.50<br>0.70 | $561,150 | 02/06/95 | 02/05/00 |
| 1275-21000-110-00D | Germplasm Enhancement of Solanaceous Fruit Crops | J. Stommel | 0.90 | $209,768 | 02/08/95 | 02/07/00 |
| 1275-21220-061-00D | Mechanism of Disease and Pest Resistance in Major Vegetables | K. Deahl<br>S. Sinden<br>R. Whitcomb | 0.60<br>0.10<br>1.0 | $398,676 | 02/28/94 | 02/27/99 |
| 1275-21220-087-00D | Development of Methodology for Identification and Improvement of Disease Resistance in Potato and Solanum Germplasm | R. Goth | 1.0 | $308,860 | 04/11/95 | 04/10/00 |
| 1275-22000-085-00D | Detection and Identification of Allelochemically Active Components of Potato Beetle Resistant Plants | W. Cantelo<br>K. Deahl | 1.0<br>0.2 | $395,249 | 10/22/95 | 07/21/96<br>New Project Statement |

## TRUST AND PL-480 CRIS SUMMARY

| CRIS #/Log # | TITLE | COOPERATOR | SYs | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| TRUST 08707 | Evaluation of *Phytophthora infestans* for Resistance to Ridomil | CIBA-GEIGY Corporation | K. Deahl | $1,500 | 01/01/95 | 01/01/99 |
| TRUST 10991 | Improvement of Tomato Fruit Quality and Disease Resistance | Heinz USA In Review | J. Stommel | $10,000 | 05/01/96 | 04/30/97 |
| 8003-21000-219-00P | Diploid Potatoes with High Starch Content and Resistance to *Erwinia* spp. | PL-480 - Poland | K. Haynes | $ -0- | 07/01/93 | 06/30/96 |

## "TEMPORARY" CRIS'S

| CRIS#/LOG# | TITLE | COOPERATOR | SY's | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| 0500-00042-003-00D | Biotic and abiotic factors essential to control the potato diseases Ring Rot, Early Dying and Scab | SCA's | R. Goth | $212,931 | 02-05-93 | 02-05-98 |
| 0500-00042-004-00D | Management of Colorado Potato Beetles and Aphids | SCA's | W. Cantelo | $106,349 | 04-01-94 | 03-31-99 |

# SPECIFIC COOPERATIVE AGREEMENTS CRIS SUMMARY

| CRIS # | TITLE | COOPERATOR | SYs | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| 0500-00042-003-01S | *Clavibacter michiganensis* Transmission Via Tissue Culture Derived Microtubers, Plantlets and Minitubers | University of Wyoming | R. Goth | $34,468 | 04/01/93 | 03/31/96 |
| 0500-00042-003-09S | Molecular Genetics of Resistance and Immunity to Bacterial Ring Rot In Potatoes | Colorado State University | R. Goth | $180,491 | 07/01/91 | 06/30/96 |
| 0500-00042-003-15S | Development of an Antibody for Use in ELISA for Detection of Mucoid and Nonmucoid Strains of Cms | North Dakota State University | R. Goth | $19,700 | 07/01/94 | 06/30/96 |
| 0500-00042-003-16S | Use of Symptom Expression Classes to Categorize Cultivar Reaction to Bacterial Ring Rot | Cornell University | R. Goth | $32,505 | 07/01/94 | 06/30/96 |
| 0500-00042-003-17S | The Potato Ring Rot Pathogen: DNA Probes and Host-Induced Gene Expression | North Dakota State University | R. Goth | $43,734 | 07/01/94 | 06/30/96 |
| 0500-00042-003-18S | PCR-Based Detection of *Clavibacter michiganensis* subsp. *sepedonicus* | Oregon State University | R. Goth | $83,162 | 05/01/94 | 04/30/97 |
| 0500-00042-003-19S | Combining Serology and PCR to Produce an Accurate, Practical and Sensitive Assay for BRR | University of Wisconsin | R. Goth | $90,230 | 07/01/94 | 06/30/96 |

| CRIS # | TITLE | COOPERATOR | SYs | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| 0500-00042-003-20S | Development of a Monoclonal Antibody for the Detection of *Clavibacter michiganensis* spp. *sepodonicus* | North Dakota State University | R. Goth | $24,098 | 07/01/95 | 06/30/97 |
| 0500-00042-003-21S | Molecular Genetics of Immunity to Bacterial Ring Rot in Potato | Colorado State University | R. Goth | $39,947 | 07/01/95 | 12/31/97 |
| 0500-00042-003-22S | PCR-ELISA Detection of *Clavibacter michiganensis* subsp. *sepedonicus* | Oregon State University | R. Goth | $44,082 | 05/01/96 | 04/30/98 |
| 0500-00042-003-23S | Development of an ELISA System for the Detection of *Clavibacter michiganensis* ssp. *sepedonicus* | North Dakota State University | R. Goth | $24,631 | 07/01/96 | 06/30/98 |
| 0500-00042-003-24S | Detection and Characterization of Nonmucoid Strains of the Potato Ring Rot Pathogen | North Dakota State University | R. Goth | $47,420 | 07/01/96 | 06/30/98 |
| 0500-00042-003-25S | Effect of Cropping Practices on the Epidemiology and Control of Verticillium Wilt of Potato | University of Idaho | R. Goth | $24,490 | 07/01/96 | 06/30/97 |
| 0500-00042-003-26S | A PCR-Based Protocol for Ring Rot Diagnosis in Potato Tubers | Cornell University | R. Goth | $13,714 | 07/01/96 | 12/31/97 |
| 0500-00042-003-27S | Quantitative Detection and Differentiation of Verticillium spp. Using Molecular Methods | University of Wisconsin | R. Goth | $31,836 | 06/01/96 | 05/31/97 |
| 0500-00042-003-28S | Importance of Subspecific Groups of *Verticillium dahliae* in Potato Early Dying Disease | Ohio State University | R. Goth | $24,490 | 06/01/96 | 05/31/98 |

| CRIS # | TITLE | COOPERATOR | SYs | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| 0500-00042-004-05S | Incorporation of Resistance to Green Peach Aphid, Potato Leafroll Virus, and Potato Virus Y | University of Minnesota | W. Cantelo | $81,822 | 05/01/93 | 04/30/96 |
| 0500-00042-004-08S | Developing Strategies to Manage Cryolite Resistance of Colorado Potato Beetle on Potato | Pennsylvania State University | W. Cantelo | $56,983 | 05/01/93 | 04/30/96 |
| 0500-00042-004-09S | Controlling CPB in Overwintering Aggregation Sites Using *Beauveria bassiana* and Plastic-Lined Trenches | University of Massachusetts | W. Cantelo | $55,087 | 07/17/94 | 03/31/97 |
| 0500-00042-004-10S | Response of CPB Predator to Spatial Variation in CPB Density: Implications for Pest/Resistance Management | North Carolina State University | W. Cantelo | $45,032 | 04/01/94 | 03/31/97 |
| 0500-00042-004-11S | Effect of Harvest Date and BT Treatments on CPB Overwintering Survival and Susceptibility to Fungus | North Carolina State University | W. Cantelo | $24,625 | 05/01/94 | 04/30/96 |
| 0500-00042-004-12S | Comparing Direct with Indirect Selection for Resistance to BT Endotoxin in CPB | Ohio State University | W. Cantelo | $23,191 | 04/01/94 | 03/31/96 |
| 0500-00042-004-13S | Development and Biochemical Evaluation of Leptine-Based Resistance to the CPB | Virginia Polytechnic Inst. | W. Cantelo | $37,238 | 07/01/94 | 12/31/95 |
| 0500-00042-004-14S | Novel Formulation and Delivery Methods for *Beauveria bassiana* to Control Green Peach Aphid and CPB | University of Idaho | W. Cantelo | $30,436 | 05/01/94 | 04/30/96 |
| 0500-00042-004-15S | Row Mixture and Toxic Barriers: Resistance Management Tactics for At-Planting Insecticides in Potatoes | University of Maryland | W. Cantelo | $38,812 | 05/01/94 | 04/30/97 |

| CRIS # | TITLE | COOPERATOR | SYs | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| 0500-00042-004-21S | Identification and Management of Potential Resistance to Admire and Agri-mek in the CPB | Michigan State University | W. Cantelo | $21,511 | 05/01/95 | 04/30/96 |
| 0500-00042-004-22S | Reducing CPB Insecticide Application with a Site-Specific Pest Management Program | Pennsylvania State University | W. Cantelo | $31,747 | 05/01/95 | 04/30/97 |
| 0500-00042-004-23S | Assessment of Novel Tactics for Management of Insecticide Resistance in the CPB | Cornell University | W. Cantelo | $24,385 | 05/01/95 | 04/30/97 |
| 0500-00042-004-24S | Laboratory Selection and Characterization of Colorado Potato Beetle Resistance to Imidacloprid | University of Maryland | W. Cantelo | $26,876 | 05/01/95 | 04/30/96 |
| 0500-00042-004-25S | Development of Potato Varieties with Resistance to the Colorado Potato Beetle and Other Pests | Cornell University | W. Cantelo | $38,890 | 05/01/96 | 04/30/97 |
| 1275-21000-085-01S | Characterization of Immigrant Genotypes of *Phytophthora infestans* | Cornell University | K. Deahl | $22,154 | 07/01/96 | 06/30/97 |
| 1275-21000-085-02S | Improved Measurement of Fungicide Coverage on Potato Leaves for Late Blight Control | North Dakota State University | K. Deahl | $10,922 | 07/01/96 | 06/30/97 |
| 1275-21000-085-03S | Molecular Markers to Detect Sexual Recombination in *Phytophthora infestans* | North Dakota State University | K. Deahl | $22,633 | 07/01/96 | 06/30/98 |
| 1275-21000-109-05S | Breeding and Evaluation of Late Blight Resistance in Potatoes | University of Maine | K. Haynes | $30,000 | 02/06/95 | 03/31/96 |

| CRIS # | TITLE | COOPERATOR | SYs | AMT | START DATE | END DATE |
|---|---|---|---|---|---|---|
| 1275-21000-110-01S | Laboratory and Field Evaluation of *Lycopersicon* Germplasm Collections for Durable Resistance to Late Blight | University of California, Riverside | J. Stommel | Proposed | | |
| 1275-21220-061-02S | Management of Metalaxyl-Resistant *Phytophthora infestans* | University of Wisconsin | K. Deahl | $98,000 | 04/01/95 | 09/30/96 |

As of: 08/30/95 | Annual Resource Management Plan System | Page: 1
Annual Operating Plan | Version FY94b

Account Code: 601-1275-145 Vegetable Laboratory
Mode Code: 03-10-12-1275-45-00-00-00
MU Name: VEGETABLE LABORATORY
Location Name: Plant Sciences Institute
Area Name: BELTSVILLE AREA
Agency: 03

This MU occupies only Federal space

| Distr. of Resources | Pos Cat | Obj Cls | Prior Year Dollars | Prior Year FTE | Current Year Dollars | Current Year FTE | Difference Dollars | Difference FTE | CRIS/IRC Distribution | |
|---|---|---|---|---|---|---|---|---|---|---|
| Personal Services | | | | | | | | | 1275-21000-085-000 | 7.16% |
| Scientific Effort | | | | | | | | | 1275-21000-088-000 | 9.43% |
| Research Scientist | 1 | 1000 | 649,737 | 8.00 | 680,859 | 8.00 | 31,122 | | 1275-21000-089-000 | 7.66% |
| Service Scientist | 4 | 1000 | | | | | | | 1275-21000-106-000 | 11.37% |
| Support Effort | | | | | | | | | 1275-21000-109-000 | 22.88% |
| Non Perm Res/Serv Sci. | 2 | 6000 | 46,966 | 1.00 | 105,698 | 2.00 | 58,732 | 1.00 | 1275-21000-110-000 | 7.72% |
| Support Scientist | 3 | 6000 | 48,975 | 1.00 | | | -48,975 | -1.00 | 1275-21220-061-000 | 11.20% |
| Technician/Aid/Asst | 5 | 6000 | | | | | | | 1275-21220-087-000 | 12.37% |
| Specialist | 6 | 6000 | | | | | | | 1275-22000-083-000 | 10.20% |
| Technician/Aid (Eng. & Sci.) | 7 | 6000 | 376,910 | 10.12 | 403,401 | 10.62 | 26,491 | 0.50 | | |
| Trades & Crafts | 8 | 6000 | 26,513 | 1.00 | | | -26,513 | -1.00 | | |
| Admin. Support | 9 | 6000 | 63,317 | 2.40 | 43,900 | 1.40 | -19,417 | -1.00 | | |
| (Other) | | 6000 | | | | | | | | |
| Overtime | | | | | | | | | | |
| Premium Pay | | | | | | | | | | |
| Promotion/Award/QSI/Merit Pay | | | 19,390 | | 18,951 | | -439 | | | |
| PERSONNEL SUBTOTAL | | | 1,231,808 | 23.52 | 1,252,809 | 22.02 | 21,001 | -1.50 | | |
| Travel of Persons | | 2100 | 30,100 | | 28,200 | | -1,900 | | | |
| Transportation | | 2200 | 8,060 | | 8,460 | | 400 | | | |
| Rent, Comm., Utilities | | 2300 | 21,700 | | 22,200 | | 500 | | | |
| Printing & Reproduction | | 2400 | | | 8,200 | | 8,200 | | | |
| Contract & Other Services | | 2500 | 50,100 | | 51,080 | | 980 | | | |
| Repair & Maintenance | | 2530 | 4,910 | | 15,330 | | 10,420 | | | |
| Research Support Agreement | | 2554 | 205,000 | 6.50 | 108,255 | 5.10 | -96,745 | -1.40 | | |
| Supplies and Materials | | 2600 | 139,679 | | 214,128 | | 74,449 | | | |
| Equipment | | 3100 | 18,900 | | 19,400 | | 500 | | | |
| Land & Structure | | 3200 | | | | | | | | |
| Extramural | | 4000 | 27,500 | | 25,000 | | -2,500 | | | |
| ALL OTHER - SUBTOTAL | | | 505,949 | 6.50 | 500,253 | 5.10 | -5,696 | -1.40 | | |
| TOTAL | | | 1,737,757 | 30.02 | 1,753,062 | 27.12 | 15,305 | -2.90 | | |
| BASE FUNDS | | | 1,741,750 | | 1,706,972 | | -34,778 | | | |
| Management Criteria | | | | | | | | | | |
| Percent in Salaries | | | | 58.59% | | 55.51% | | -3.08% | | |
| Target Percent in Salary | | | | 55.00% | | 49.00% | | -6.00% | | |
| Support Years per SY | | | | 1.94 | | 1.75 | | -0.19 | | |
| Total Dollars per SY | | | 305,163 | | 305,036 | | -127 | | | |
| Discretionary Funds per SY | | | 30,855 | | 41,184 | | 10,329 | | | |
| Percent Discretionary | | | | 10.11% | | 13.50% | | 3.39% | | |
| | | | | | | | | | | 100.00% |

REMARKS: IRC = $687,226 Recruitment Incentives under Demo Project = $0

K. L. Dahl 8/9/95 — 9/6/95

FUNDHOLDER - Stephen L. Sinden DATE APPROVING OFFICIAL DATE TELEPHONE NO.

As Of: 08/30/95

05-10-12-1275-45-00-00-00
Vegetable Laboratory

Annual Resource Management Plan System
Position Staffing Plan
BELTSVILLE AREA
Plant Sciences Institute



| Employee Name | Position Number | Position Title | Pay Plan & Grade(FPL) | Status | FTE | Salary | Footnote | EOD Date/ RA Exp Date |
|---|---|---|---|---|---|---|---|---|
| Sinden, Stephen | 183254 | Supervisory Plant Physiologist | GM-15( 0) | PFT | 1.00 | 100,320 | L2 | |
| Abdul-Baki, Aref | 188189 | Research Plant Physiologist | GM-15( 0) | PFT | 1.00 | 102,094 | L1 | |
| Ewashkow, Peter J. | 789170 | Agricultural Sci Res Tech | GS- 5( 9) | PFT | 1.00 | 33,110 | | |
| Cantelo, William | 183255 | Supvsry. Research Entomologist | GM-14( 0) | PFT | 1.00 | 92,237 | L1 | |
| Goth, Robert | 183256 | Research Plant Pathologist | GM-14( 0) | PFT | 1.00 | 86,516 | L1 | |
| Goins, Ernest | 783268 | Biolcl Sci Techn (Plants) | GS- 9( 9) | PFT | 1.00 | 43,970 | M1 | |
| Frazier, Karen | 788203 | Biolcl Sci Techn (Plants) | GS- 6( 7) | PFT | 1.00 | 30,999 | | |
| Sanford, Lind | 183258 | Research Geneticist (Plants) | GM-13( 0) | PFT | 1.00 | 78,600 | | |
| Pearson, Blev | 783269 | Agri Sci Res Techn (Plants) | GS- 7( 7) | PFT | 1.00 | 39,153 | M1 | |
| Deahl, Kenneth | 183259 | Research Plant Pathologist | GM-13( 0) | PFT | 1.00 | 72,830 | L1 M2 | |
| Scott, David L. | 289251 | Research Microbiologist | GS-12(12) | TFT | 1.00 | 58,170 | E1 | 09/02/97 |
| Demuth, Suzanne | 788077 | Biolcl Sci Lab Tch (Biochem) | GS- 9( 9) | PPT | 0.62 | 28,227 | | |
| Haynes, Kathleen | 184033 | Research Geneticist (Plants) | GM-13( 0) | PFT | 1.00 | 76,172 | L1 | |
| DeLong, Karl | 783262 | Biological Science Technician | GS- 7( 9) | PFT | 1.00 | 43,125 | | |
| Thomas, Charles | 783265 | Biolcl Sci Technch (Plants) | GS- 7( 7) | PFT | 1.00 | 38,443 | M1 | |
| Fleck, Diane | 788075 | Biolcl Sci Lab Tech (Plants) | GS- 7( 7) | PFT | 1.00 | 38,388 | | |
| Bragg, Merle | 788085 | Agri Sci Research Tch (Plants) | GS- 6( ) | PFT | 1.00 | 31,271 | | |
| Stommel, John | 188073 | Research Geneticist (Plants) | GS-13( 0) | PFT | 1.00 | 72,090 | L1 M2 | |
| Braun, Linda | 788182 | Biolcl Sci Lab Techn (Plants) | GS- 8( 9) | PFT | 1.00 | 36,018 | | |
| VACANT | 289124 | Plant Geneticist | GS-11( 0) | TFT | 1.00 | 47,528 | F Z1 | 08/20/96 |
| Perez, Frances | 788074 | Biolcl Sci Lab Tch (Biochem) | GS- 8( 8) | PFT | 1.00 | 40,697 | | |
| McCue, Kathleen | 983270 | Secretary (Office Automation) | GS-6( ) | PFT | 1.00 | 29,500 | | |
| Conley, Vio | 988204 | Office Automation Assistant | GS- 5( 5) | PPT | 0.40 | 14,400 | | *CONVERT TO PFT |
| | | | | | 22.02 | 1,233,858 | | |

Non Federal FTE

| Type | FTE |
|---|---|
| Research Support Agreement | 5.10 |
| Support Service Contract | 0.00 |
| Donated | 0.00 |
| Revolving Funds | 0.00 |
| Other | 0.00 |
| | 5.10 |

Footnotes:

E1 -Research Associate - Headquarters Approved, Headquarters Funded.
F -Research Associate - Locally Approved, Locally Funded.
L1 -Level I SY (i.e., Lead Scientist/Project Leader).
L2 -Level II SY (i.e., Research Leader).
M1 -Exigency employee must report to or remain on work site regardless of extreme weather or other emergency conditions.

| | | | | |
|---|---|---|---|---|
| YUSKA, DANIEL | 0B9310 | BIOLOGICAL AID | GS- 4 | TPT |
| PETERS, TODD | 0B9309 | BIOLOGICAL AID | GS- 4 | TPT |
| WHITCOMB, ROBERT F. | 1B9327 | RESEARCH ENTOMOLOGIST | GS- 15 | |
| HENEGAR, ROBERTA | 7B692 | BIOLOGICAL SCI. LAB TECH | GS- 9 | |

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**Proposed FTE Changes**

Stephen L. Sinden (#1B3254) will retire 7/96.

Joseph C. Dickens (#1B9369) will join the lab 6/96.

Locally funded Research Associate Stanley P. Kowalski (GS-11/#2B9369) will join the lab 7/96.

Locally funded Research Associate Catherine M. Ronning (GS-11/#2B9126) will join the lab 7/96.

FUTURE-YEAR PROJECTIONS

Institute: PSI
Date: July 27, 1995

MU Name: Vegetable Laboratory
Initials: RL _____ AO _____

| | | FY 1996 | | FY 1997 | | FY 1998 |
|---|---|---|---|---|---|---|
| BASE FUNDS (Net to Location) | | $2,444,390 | | $2,444,390 | | $2,444,390 |
| ADJUSTMENTS (Identify source of funds) | | | | | | |
| Temporary funds Natl. Potato Council pass-through funds | | $420,000 | | $420,000 | | $420,000 |
| Grants, etc | | | | | | |
| FEDERAL SALARIES (WGI's, promotions, retirements, replacements, merit pay, etc.) | | $1,203,385 | | $1,239,487 | | $1,276,671 |
| Explanation of Varience to ARMPS: (attach separately) | | | | | | |
| % assumed increase from '96-97 & from '97-98 | | | 3.00% | | 3.00% | |
| BIOTECHNOLOGY ASSESSMENT (Current FY ONLY) | | $3,991 | | | | |
| RSA SALARIES AND UTILITIES (Only those Absolutely Necessary) | | $108,255 | | $108,255 | | $108,255 |
| INDIRECT RESEARCH COSTS | | $687,226 | | $707,843 | | $729,078 |
| IRC Inflation Rate Worksheet | | | | | | |
| IRC 1996 $687,226 | | | | | | |
| FY95-96 % change | -2.3% | | | | | |
| IRC 1995 $703,544 | | | | | | |
| FY94-95 % change | 4.6% | | | | | |
| IRC 1994 $672,589 | | | | | | |
| FY93-94 % change | -14.7% | | | | | |
| IRC 1993 $788,381 | | | | | | |
| Percentage Change Average (Inflation rate used for IRC) | | | -0.0413 | | -0.0413 | |
| OTHER FIXED COSTS | | $37,530 | | $38,656 | | $39,816 |
| Postage | 3800 | | | | | |
| Utilities | 8000 | | | | | |
| Telephones | 10400 | | | | | |
| Repair & Maintenance (includes Mtn. Contracts) | 15330 | | | | | |
| Other_____ | 0 | | | | | |
| Inflation factor | | | 3.00% | | 3.00% | |
| EXTRAMURAL AND OTHER DIRECTED TRANSFERS OF FUNDS | | $25,000 | | $0 | | $0 |
| BALANCE AVAILABLE (Discretionary) | | $379,003 | | $350,149 | | $290,570 |
| SY's | | 8.00 | | 8.00 | | 8.00 |
| DISCRETIONARY $'s PER SY | | $47,375 | | $43,769 | | $36,321 |
| Total Federal FTE's | | 21.52 | | 21.52 | | 21.52 |

General Notes:
o Use FY 1996 base funds for FY 1997 and FY 1998 (assume no increases). o Proposals for resolving underfunding problems may be addressed briefly on the back of this form. Any information you include will be restricted to use in the Area Director's office ONLY. Do not use solutions to performance problemsto resolve funding problems. o If a retirement is going to be used to resolve funding shortages, what will be the backup plan should the retirement not occur?

# MANAGERIAL
# COMMENTS, CONCERNS AND OPPORTUNITIES

## Personnel/Position Management

In August, 1993, Dr. Stephen L. Sinden (current Research Leader) became ill and was partially impaired in 1994-1996. Dr. Sinden plans to retire in August 1996. During this time period Dr. Kenneth L. Deahl has served as acting Research Leader. Rationale for filling Dr. Sinden's position: The mission of the Vegetable Laboratory is to genetically improve the quality and pest resistance of vegetables. Through traditional breeding and using biotechnology, scientists develop potatoes, tomatoes and other vegetables with superior nutritional quality, disease and pest resistance. Work in the Vegetable Laboratory also has led to recognition of a potential food safety problem for high levels of natural toxicants in certain germplasm sources. New and more sensitive HPLC analytical techniques were developed to detect and identify the 20 different forms of alkaloids present in potato and tomato species. Potential new varieties from ARS and state breeding programs are tested for these toxicants in the Vegetable Laboratory prior to release to assure food safety and to prevent the introduction of potentially toxic alkaloids from wild species into new commercial varieties. Since much is still unknown about the chemistry and the biology of these compounds, monitoring their levels is not sufficient for industry requirements. Therefore, the National Potato Council considers this position vital to the future of the potato industry. Two research associates were hired (#2B9361 and #2B9126) to conduct cardinal and pivotal objectives of the programs.

## Funding

Long-term funding for the new permanent entomology scientist (Joseph C. Dickens from ICEL-#1B9369) and technical support is a major issue. The full-time positions hired in a CRIS #1275-22000-085-00D that cannot fully support the position in the future without new source of funding. Additional permanent funding ($250,000) is still needed to support this program.

## Facilities

- Laboratories are state-of-the-art with the move into the new Horticultural Sciences Research Building, 010A, in June 1996. However, several of the labs (tissue culture) and equipment rooms need additional cooling capacity and electrical upgrading to be totally functional.

- Needed renovation of Greenhouse 3-4/Range 2 for occupancy by entomologists that will allow them to move from BARC-East is not complete. This should be completed by the end of July.

- The greenhouses (14 & 15) are in need of repair or replacement. The cement walkways have cracked and/or heaved, creating dangerous working conditions. The overhead supporting structures are rotting with age. One set of lights has already come crashing down. One greenhouse has sodium vapor lamps. The installation of sodium vapor lamps in the second greenhouse would improve plant growing conditions.

- The final phase of Range 2 renovation at BARC-West was completed in March FY 96. Three researchers now occupy portions of Greenhouse 2.

**Major Acquisitions**

A replacement tractor for the ARS potato breeding farm in Presque Isle, Maine was a FY95 high priority request that was funded by PSI ($38,000).

**ADP**

ADP capacity is adequate. The VL acquired two new pentium computers and LAN components were purchased jointly with FNCL and FL to complete the LAN system in 010A. The lab established a Home Page on the World Wide Web during FY96.

**Assistance**

- In FY96 a total of $188,000 outside sources of funding was committed to the VL to fund ongoing or cooperative research. $140,000 was received in 1995 and $121,000 was received in 1994.

- A Headquarter's funded Postdoctoral Research Associate ($50,000) proposal was awarded to Dr. K.L. Deahl for research on the late blight disease. A post-doc was hired in August '95 (#2B9251)

- Permanent funding of VL continues to be eroded. New sources of funds for newly emerging and high priority projects will be sought to meet the escalating IRC charges. Efforts to obtain outside sources of funds (Grants, Trust, CRADAS) have been encouraged.

- As we continue to seek ways to reduce IRC and other controllable costs, without severely impacting the research, we plan to continue to carefully examine office and laboratory space needs, student help, and farm labor inputs. In this process, we have thus far identified means of reducing space and farm labor by consolidating offices, installing drip irrigation, and mechanizing tasks previously carried out by farm laborers in field plots. The latter necessitates farm equipment purchases but reduces our dependence on farm labor. The drip irrigation, coupled with mulching, is also a water saving measure which should help reduce Area costs for water.

- Funds from the Director's office to the Sustainable Agricultural Program at BARC during the past 3 years (1994-1996) totaled $278,500. Support to the Vegetable segment of the sustainable agricultural program during the 3-year period amounted to about $70,000.

- Field assistants and technical support for the horticulturist in the Sustainable Agriculture Program are currently being funded as temporary positions; outside "soft" funds and Area Office funds are being used to supplement expenditures for supplies and materials. Additional permanent funding is needed to support this program.

## OPPORTUNITIES/PROPOSED NEW THRUSTS

**Improve Nutritional Value**

- Vegetables are a major source of essential vitamins, soluble fiber and other important nutrients in the American diet. Both tomato and potato make a significant nutritional contribution to the U.S. diet. An average potato or ripe tomato contains only intermediate levels of pro-vitamin A carotenoids and vitamin C, yet makes important contributions to dietary intake of vitamin A (9.5%, tomato) and vitamin C (11.5%, tomato; 25%, potato) by virtue of the volume of tomato and potato products which are consumed. There is wide genetic variability in tomato and potato for vitamin C, carotenoids (pro-vitamin A, beta-carotene, lycopene, lutein, violaxanthin), vitamin B6, and other vitamins and nutrients. Little effort has been made to date to improve or even maintain the nutritional value of these two major vegetables. Enhanced nutritional value of our foods is a national priority. States and private industry are not likely to pursue long-range research to improve these characters in our food crops which will benefit public health but give no immediate monetary return. Beltsville is the ideal location for research to improve the nutritional content of vegetables. At Beltsville, there is a major Human Nutrition Institute and a Carotenoid Management Unit dedicated to studying the impact of carotenoids on human health. Working with experts on human nutrition and nutrient composition of vegetables, the potato and tomato scientists in the Vegetable Laboratory could make a very significant contribution to the enhancement of vegetable nutritional quality. Additional funding for existing projects within the Vegetable Laboratory is needed to expand research on nutritional quality and develop cooperative studies with the Human Nutrition Institute and Carotenoid Management Unit. When funds are available we should hire a natural products biochemist to work with the tomato geneticist and HNI to improve the nutritional content of tomato.

**Acceleration of Tomato Breeding**

- Breeding for quantitatively inherited characters such as quality components, pest resistance, and yield can be greatly accelerated if genetic markers associated with the traits are identified and utilized in making selections. Molecular marker technology (e.g. RFLP, RAPD, SSR) is available for some crops and has facilitated plant improvement by allowing determination of the genotype of individual plant or germplasm sources in the laboratory. In tomatoes, RFLP and RAPD technology is highly advanced and the technology has already proven useful in developing germplasm with higher solids (UCD, Davis, California) and insect resistance (Native Plant Resources, Inc.). Vegetable Laboratory scientists have identified unadapted tomato germplasm with enhanced fruit pigmentation and pest resistance. Introduction of these characters into adapted breeding lines is just beginning. Using molecular marker technology, breeding progress would be greatly accelerated. The marker technology and information developed in this project would also be used to enhance tomato for other horticultural characters such as solids and stress tolerance. A temporary Research Associate with training in molecular genetics and

experience in molecular marker technology is needed for two years to help develop selectable markers for this project.

**Team: Late Blight**

- While the potato breeding program has had an ongoing late blight breeding effort, the emergence of more virulent strains of late blight necessitates increasing our breeding effort for resistance to this disease. We will be incorporating resistance from wild species germplasm into the breeding program and evaluating resistant selections for their processing abilities or fresh market potential through cooperation with other ARS scientists. We are attempting to determine the nature of this resistance. Recently a team of scientists from the VL, PMBL, and MPPL was established to accelerate the resistance work by the development of late blight resistant germplasm utilizing small antimicrobial protein (defensin) in transformed potatoes. Although a key member is retiring (L. Owens), he plans to continue the project in retirement. Plant defensin work is highly advanced and the technology has already proven useful in developing germplasm with high levels of resistance to other diseases. Introduction of these characters into adapted breeding lines is just the beginning and promises to be a valuable tool for introducing disease resistance and other desirable characteristics into the major cultivars. A Research Associate with training in molecular genetics and experience in potato transformation is needed for two years to expedite this project.

# SAFETY AND HEALTH REPORT

The Safety and Health Inspection was conducted by Rick Walton of the Safety, Occupational Health and Environmental Section (SOHES) on March 19, 1996. There were no major deficiencies. Deficiencies such as labels on ice machines, microwaves, and cabinets have been corrected by laboratory personnel. The FMOD report of deficiencies and actions taken follows.

United States Department of Agriculture
Agricultural Research Service
Beltsville Area Beltsville Agricultural Research Center
Beltsville, Maryland 20705

March 27, 1996

SUBJECT: Report of FMOD Walk-Through

TO: Dr. Kenneth Deahl, Research Leader
Dr. Jan van Schilfgaarde, Acting Area Director
Dr. Barbara Leonhardt, Acting Institute Director
John Van de Vaarst, Acting Deputy Area Director
Tim Badger, Acting Area Administrative Officer
Marilyn Low, Management Analyst
Rick Walton, Safety Representative
Pam Cochran, Realty Specialist
Frank Messineo, Facility Engineering Representative

FROM: Gary Unger, Administrative Officer
West Side Service Center

Gary Unger

Enclosed please find the report of the March 19, 1996, FMOD Walk-Through of the Vegetable Laboratory.

If you have any questions, I may be reached on 504-6816.

# REPORT OF FMOD WALK-THROUGH

INSTITUTE: Plant Sciences

LABORATORY: Vegetable

DATE OF WALK-THROUGH: March 19, 1996

DATE OF LAB REVIEW: May 30, 1996

FMOD PERSONNEL CONDUCTING WALK-THROUGH:

Pam Cochran, Real Property Office
Frank Messineo, Facility Engineering Branch
Rick Walton, Safety and Health Office
Gary Unger, West Side Service Center
Sheree Hawkins, West Side Service Center

KEY LABORATORY PERSONNEL:

Dr. Kenneth Deahl

INSTITUTE PERSONNEL:

Marilyn Low

OVERVIEW:

The mission of the Vegetable Laboratory is to genetically improve the quality and pest resistance of vegetables and develop more efficient production practices. Through traditional breeding and use of biotechnology, scientists develop potatoes, tomatoes, and other vegetables with superior nutritional quality, disease and insect pest resistance and high consumer acceptability. Scientists also develop production systems that reduce inputs of farm chemicals and lower production costs.

OBSERVATIONS:

I. A. Observation: The autoclave waste dumpster behind building 006 needs to be emptied on a more timely basis. Currently, the dumpster will be full, prohibiting lab personnel from dumping additional waste.

B. Discussion: The problem with the dumpster being full is not the frequency of the dumps, but the volume that the dumpster can handle.

C. Recommended Action: A second dumpster has been ordered and will be placed behind building 010A. The new dumpster will alleviate the problem of the dumpster being full behind building 006.

II. A. Observation: Building 010A still has a host of problems (structural, electrical, heating and air conditioning, etc.) contributing to disruption in the laboratory.

B. Discussion: The participants of the walk-through were aware of most of the concerns regarding the building. Many of the problems were discussed and recommendations were made to solve many of the problems.

C. Recommended Action: Building occupants should continue to work with the Facility Engineering Branch to correct the numerous building concerns.

**NOTE:** As of 5/15/96 tissue culture rooms are still not maintaining cool enough temperatures. FMOD has proposed to install additional cooling units in these rooms in the future.

Equipment rooms need additional electrical power before 1/2 of the equipment can be powered.

Name: **AREF. A. ABDUL-BAKI**

Title: **RESEARCH PLANT PHYSIOLOGIST**

CRIS Project No. **1275-21000-088D**

Title: **Evaluation of Modern Vegetable Crop Management Systems and Cultivars, and Development of Alternative Systems to Maximize Land Use and Productivity on Farms.**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objective:** Evaluate conventional production systems and management practices in production of vegetables, and develop alternative production systems and management practices that are healthier to the environment and consumer.
**Accomplishments:** Two alternative production systems have been developed to replace conventional systems. One system is used for the production of summer grown vegetables (e.g. tomatoes, peppers, muskmelons, sweet corn, green beans, and utilizes winter annual cover crops (legumes and grasses); the other is used for the production of fall crops (cabbage, broccoli, cauliflower, kale, etc...) and utilizes summer cover crops (legumes and grasses). Both alternative systems require minimum tillage and both fix nitrogen, add organic matter to the soil, prevent soil erosion, and eliminate the need for polyethylene mulches and pre-emergence herbicides. Vegetable yields in the alternative systems are 30 to 40% higher and production cost is lower than in the conventional systems.
**Plans:** Evaluate the alternative systems using combinations of cover crops; extend the evaluation to include wider geographical areas and private farms and a larger number of vegetable crops.

**Objective:** Evaluate and select vegetable and cover crop varieties that maximize land use and productivity under alternative systems and develop rotations which support sustainability through diversifying crops, conserving soil, and renewable resources.
**Accomplishment:** Fifteen species of legume and grass cover crops were evaluated to use for mulches in the alternative systems. Evaluation criteria included production of biomass, N fixing ability, recycling macro-and micro-nutrients, adaption to the area, fitness into the cropping rotation, efficiency in stopping soil erosion, and controlling weeds.

Major vegetables evaluated for performance in the alternative systems included 14 varieties of fresh-market tomatoes, 10 varieties of processing tomatoes, 8 varieties of peppers, 3 varieties of sweet corn, 3 varieties of muskmelons, 2 varieties of green beans, 2 varieties of broccoli, 1 variety of cauliflower, and 1 variety of cabbage.

Hairy vetch alone or combined with rye and crimson clover was superior as a cover crop for summer grown vegetables. Forage soybean done or in combination with foxtail millet was superior as a cover crop for fall vegetables.

**Plans:** Develop vegetable production rotations using high cash value vegetables and evaluate performance and production cost in comparison with conventional systems. As part of developing crop rotations, the integrated pest management system will be implemented. The fate of nitrogen will be monitored to assess the efficiency of alternative production systems in providing free nitrogen and conserving it by recycling leftover nitrogen and making it available to the next vegetable crop. Leaching of nitrogen into groundwater and buildup of soil organic matter will also be monitored.

## 2. CURRICULUM VITAE

**Educational History**

Ph.D., Plant Physiology, University of Illinois, Urbana, Illinois. 1964.
M.S., Horticulture, University of Illinois, Urbana, Illinois. 1961.
Ingenieur Agronom., American University of Beirut, Lebanon. 1956.
B.S., General Agriculture, American University of Beirut, Lebanon. 1956.

**Post-graduate Employment History**

| | |
|---|---|
| 1988-Present | Research Plant Physiologist, Vegetable Laboratory, USDA, ARS, Beltsville, MD. |
| 1987-1988 | Research Plant Physiologist, Plant Molecular Genetics Laboratory, USDA, ARS, Beltsville, MD. |
| 1982-1987 | Science Advisor, National Council for Scientific Research, Beirut, Lebanon. |
| 1981-1982 | Technical Director of the OICD/Saudi Arabian Joint Research Program on Agriculture and Water. Riyadh, Saudi Arabia. |
| 1975-1980 | Supervisory Plant Physiologist, Head, Seed Research Laboratory, USDA, ARS, Beltsville, MD. |
| 1972-1975 | Research Plant Physiologist, Post-harvest Physiology Laboratory, USDA, ARS, Beltsville, MD. |
| 1967-1972 | Research Plant Physiologist, Seed Research Laboratory, USDA, ARS, Beltsville, MD. |
| 1966-1967 | Research Associate, Biology Dept., Univ. Of California, Santa Cruz, CA. |
| 1965-1966 | Research Associate, Botany Dept., Univ. of Michigan, Ann Arbor, MI. |
| 1964-1965 | Assistant Professor in Biology, Eastern Michigan University, Ypsilanti, MI. |
| 1956-1960 | Education Advisor to the Libyan Government under the U.S. Foreign Aid Program to Libya. |

**Society Offices Held**

American Society of Plant Physiologists
Member, President, Vice President, and Secretary of Washington Area Chapter
American Society of Horticultural Science
Member, 1967-present
Pennsylvania Association for Sustainable Agriculture
Member, 1990-present
Maryland Organic Farmers Association

Member, 1990-Present
New Jersey Vegetable Growers Association.
Member, 1990-Present
Mid-Atlantic Vegetable Workers Association.
Member, 1990-present

**Editorial Board Appointments**
Associate Editor, 1990-1993. HortScience.
Associate Editor, 1990-1994. Journal of the American Society for Horticultural Science.

**Advisory Appointments**
Representative of the U.S. Government and Designated Authority for the Organization for Economic Cooperation and Development (OECD) Seed Scheme, 1979-1980.
Vice President of the Advisory Board, OECD Seed Scheme, 1980.
Member of the Advisory Board, Association of Official Seed Certification Agencies in the U.S. and Canada, 1979-1980.
Chairman and Committee member of the AID/BARD Panel, 1989-present.
Coordinator of the horticultural project, Sustainable Agricultural Program at BARC, 1993-present.
Advisor to the office of the Prime Minister, Government of Lebanon, on Agricultural and Environmental Research and Policy, 1982-1987.
Consultant to the United National Development Program on Preparing a National Seed Production Scheme and drafting National Seed Law for the Syrian Arab Republic, 1977-1978.
Consultant to the Food and Agricultural Organization/UN on training programs for seed production and certification in the Yemen Arab Republic, 1986.
Consultant to the International Center for Agricultural Research in Dry Areas on training specialists in 11 countries in the Middle Eastern Region on seed production, certification, testing, storage, and marketing, 1982-1987.

**Honors and Awards**
Recipient, Honorary Citizenship of the State of Tennessee in recognition of pioneering studies on the influence of fallout radiation on plant and animal life. 1965.
Recipient, the Annual Award of the American Canners Association for the best publication in 1971 in the Journal of the American Society for Horticultural Science.
Recipient of the Silver Medal Award presented annually to the author of the second-best publication that appeared in the Middle East Agriculture Journal for the year 1987.
Recipient of the American Society for Horticultural Science award for his contribution as an Associate Editor for the Journal of American Society for Horticultural Science (1990-1994) and an Associate Editor for HortScience (1990-1993).
Elected Vice President of the Advisory Board of the Organization for Economic Cooperation and Development (OECD) Seed Schemes. 1980.

Recognized by the Secretariat of the International Seed Testing Association (ISTA) for the outstanding accomplishment of translating into Arabic the 1985 ISTA Rules and Annexes Book and the "Handbook on Seed Testing." The request was made by FAO/UN.

Recipient, several cash awards for outstanding performance in FY- 1993, 1994, and 1995. ($2,000 each year).

First recipient of the 1994 "Friend of the Small Farm Award". This award was initiated as an annual award in 1994 by the Growing for Market Magazine and the Fairplain Publications in recognition of the incumbent's research and named after him.

Recipient of the "1994 ARS Technology Transfer Award for Outstanding Effectiveness in Transferring Technology to Farmers for Production of Vegetables with a Reduced Input System Developed Through His Research".

Recipient of the "1995 Federal Laboratories Consortium Award" for effective transfer of technology to farmers.

Member of the Honorary Societies Sigma Xi, Phi Sigma, and Gamma Sigma Delta since 1963.

## 3. LIST OF PUBLICATIONS (1993-1996)

### Peer Reviewed Journal Articles

1. Haroon, S., A. Abdul-Baki, and R.N. Huettel. 1993. An *in vitro* test for temperature sensitivity and resistance to *Meloidogyne incognita* in tomato. J. of Nematology 25(1):83-88.

2. Abdul-Baki, A. and K. Haynes. 1993. Male fertility of derived tetraploids of *Solanum tuberosum* from groups Tuberosum x Phureja-stenotomum. Amer. Potato J. 70:885-895.

3. Abdul-Baki, A. and J.R. Teasdale. 1993. A no-tillage tomato production system using hairy vetch and subterranean clover mulches. HortScience 28(2):106-108. 1993.

4. Abdul-Baki, A. and T. Solomos. 1994. Diffusivity of $CO_2$ through the skin and flesh of potato tubers (*Solanum tuberosum* cv Russet Burbank). J. Amer. Soc. Hort. Sci. 119 (4):742-746.

5. Abdul-Baki, A. and J.R. Stommel. 1995. Pollen viability and fruit set of heat-tolerant and -sensitive tomato genotypes under optimum and high temperature regimes. HortScience 30(1):115-117.

6. Teasdale, J.R. and A. Abdul-Baki. 1995. Soil temperature and tomato growth associated with black polyethylene and hairy vetch. J. Amer. Soc. Hort. Sci. 120:848-853.

7. Kelly, T.C., Y.C. Lu, A. Abdul-Baki. and J.R. Teasdale. 1995. Economics of a hairy vetch mulch system in fresh-market tomato production in the Mid-Atlantic region. J. Amer. Soc. Hort. Sci. 120:854-860.

8. Abdul-Baki, A. And S. Haroon. 1996. Temperature effects on resistance to *Meloidogyne* spp. In excised tomato roots. J. Amer. Soc. Hort. Sci. 31:147-149.

9. Abdul-Baki, A., J.R. Teasdale, R. Korcak, D.J. Chitwood, and R. Huettel. 1996. Fresh-market tomato production in a low-input alternative system using cover crop mulch. J. Amer. Soc. Hort. Sci. 31:65-69.

**Other Significant Publications**

1. Abdul-Baki, A., J.R. Teasdale., D.J. Chitwood, and R.N. Huettel. 1993. Effect of mulches on growth and yield of muskmelons. Proc. of the 24th National Agricultural Plastics Congress, pp. 303-308.
2. Abdul-Baki, A., J.R. Stommel, and J.R. Teasdale. 1994. Evaluation of processing tomato varieties in a sustainable agricultural system using hairy vetch mulch. Proc. of the 24th Annual Meeting of the Mid-Atlantic Vegetable Workers' Conference, pp. 59-64.
3. Abdul-Baki, A. and J.R. Teasdale. 1994. Sustainable production of fresh-market tomatoes with organic mulches. U.S. Department of Agriculture, Agricultural Research Service, Farmer's Bulletin FB-2279, pp. 10.
4. Abdul-Baki, A. and J.R. Teasdale. 1995. Establishment and yield of sweet corn and snap beans in a hairy vetch mulch. Proc. of Fourth National Symposium on Stand Establishment of Horticultural Crops. Monterey, California, pp. 9-16.

**Linkages with Other Laboratories:**

- Dr. **Carolyn C. Prince**. Department of Horticulture, Iowa State University, Ames, Iowa. Collaborated in testing cover crops for potential use as mulches in vegetable production.
- Dr. **Ronald Morse**. Department of Horticulture, Virginia State University and Polytechnical Institute, Blacksburg, VA. Collaborates in developing cover crop mulches, cover crops mechanical killing methods, mechanical transplanting in sods, and evaluation of vegetable varieties in no-till alternative production systems.
- Dr. **Stephen Garrison**. Rutgers Research and Development Center. Bridgetown, NJ. Collaborates in evaluation of hairy vetch mulch in large-scale production of processing tomatoes in N.J.
- Dr. **Phillip W. Tipping**. State of Maryland, Dept. of Agriculture, Annapolis, MD. Collaborates in biological control of insects in vegetables by releasing biological agents into vegetable research plots at BARC.
- Drs. **H.L. Bhardwaj and M. Rangapa**. Agricultural Research Station, Virginia State University, Petersburg, VA. Collaborate in extending the cover crop alternative production system which was developed at BARC, to the production of herbs and spices. Received a research grant under the Capacity Building Grants Program for 1890 Institutions to support this research.
- Dr. **Gene Galleta**. Fruit Laboratory, BARC. Collaborates in developing root rot resistant strawberries and sustainable cultural systems for maximizing yield and improving quality.
- Dr. **David Chitwood**. Nematology Laboratory, BARC. Collaborates in evaluating changes in population dynamics of nematodes as affected by the different vegetable cropping systems.
- Dr. **Jeffrey R. Aldrich**. Insect Chemical Ecology Laboratory, BARC. Collaborates in biological control of insect pests by releasing predators into the research plots and evaluating effectiveness of released predators in controlling harmful insects.
- Dr. **John R. Teasdale**. Weed Science Laboratory, BARC. Collaborates in evaluating efficiency of cover crop mulches in fixing N, producing biomass, and recycling nutrients in alternative vegetable production systems.
- Dr. **Thomas Devine**. Molecular Genetics Laboratory, BARC. Collaborates in evaluating and selecting forage soybean genotypes for use as cover crops in alternative farming systems for growing fall vegetables.

NAME: **WILLIAM W. CANTELO**

TITLE: **RESEARCH ENTOMOLOGIST**

CRIS Project No. **1275-22000-083**

Title: **Determine effect of allelochemicals and microorganisms on potato beetle behavior and survival.**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objective**. Develop a meridic diet containing no solanaceous plant material for the Colorado potato beetle (CPB). Determine how the adult CPB finds its host. Detect and identify allelochemically active components of solanaceous plants to be used for developing CPB resistant plants. Identify strains of entomopathogenic nematodes that kill the CPB and develop a delivery system for practical application.

**Accomplishments**. A synthetic diet, free of plant material, was developed for rearing the Colorado potato beetle (CPB) from egg to adult, although the adults were not reproductively mature until they were fed on potato foliage. Such a diet has long been sought and will be commonly used by scientists working on insect-plant interactions, for it will provide a uniform diet, unlike that in host-plant derived diets which vary in their chemistry with the source plants. Nematodes under suitable environmental conditions were able to produce 100% kill of the CPB adult and larvae. These suitable conditions include a lack of sunlight and the presence of a film of moisture on the plant. In a greenhouse with high relative humidity, most of the nematodes were dead within an hour of application. Many antidesiccants and some other promising materials were evaluated but none provided the protection needed. This group of nematodes has the potential for being widely used once a technique for extending their activity has been found. Their greatest potential is in the control of soil inhabiting insects. Four breeding lines of tomatoes with good horticultural quality were released which were moderately resistant to the CPB. Tomatoes were mulched with hairy vetch, rye straw, and clover to determine what effect the mulching would have on the CPB population and tomato yield. Adult CPB numbers on tomato plants grown in bare soil were compared with those grown in soil with mowed mulches and showed a 20% reduction with vetch, a 86% reduction with rye straw, and no reduction with clover. Comparing yields with bare plots, vetch had a 48% increase, straw a 21% decrease, and clover a 70% increase. Apparently, the straw competed with the plant for nitrogen, and also made it more difficult for the CPB to reach the plant. Although the mulch plots were only a few hundred meters from a source of thousands of CPB, none flew to the tomato plots, which supports the belief that the first summer generation of adults does little flying. The potato leafhopper (PLH) is a pest of many crops, but is rarely of concern on potatoes because the chemicals used to control the CPB also controlled the PLH. With increased specificity of insecticides, this is becoming less true. As a result, plant breeders have expanded the search for insect resistant plants to include those exhibiting resistance to the PLH. Because alkaloids are commonly the source of plant resistance to the PLH, the effect of seven plant alkaloids at several

dose levels was determined in laboratory tests. These data will enable plant breeders to select cultivars and wild species that contain sufficient alkaloids to affect PLH but not humans. The majority of the adult CPB were observed to walk in a random fashion except that 33% walked to the northeast quadrant, 32% flew, and 3.5% did not move from the release point. Mark and recapture of adults showed that all generations could fly and that a stream would not stop their dispersion. However, rotation of potato plantings for distances as short as 50 meters between fields reduced the damage in the new field. Flying was associated with the CPB being starved, or air temperatures $32^0$C or higher.

Populations of the spined soldier bug, a predator of the CPB, were augmented and the sex/aggregation pheromone of the soldier released. The mean damage to the foliage in June was 20% in plots where the bug was released, 43% with pheromone only, and 44% in untreated plots. In July foliage damage was 30% with augmentation, 71% with pheromone only, and 66% in untreated plots. The mean weight of tubers from the plots where the soldier bugs were released was 227g, from the pheromone plot was 127g, and from the untreated plots was 60g.

**Plans**: Determine the effect on each other of the variables present in pest-host ecosystems. Seek interactions among the possible components of IPM systems so as to obtain a better understanding of the dynamics present and use this information to create insecticide-free pest management programs.

## 2. CURRICULUM VITAE

**Educational History**

Ph.D., Entomology, University of Massachusetts, Amherst, Massachusetts. 1952.
M.S., Entomology, University of Massachusetts, Amherst, Massachusetts. 1950.
A.B., Biology, Boston University, Boston, Massachusetts. 1948.

**Post-graduate Employment History**

1972-present Research Entomologist, Vegetable Laboratory, USDA, ARS, Beltsville, MD.

| | |
|---|---|
| 1971-1972 | Investigations Leader, Vegetable and Ornamental Plant Insect Investigations, USDA, ARS, Beltsville, MD |
| 1966-1971 | Station Leader, Tobacco Insect Investigations, USDA, ARS, Federal Experiment Station, St. Croix, U.S. Virgin Islands. |
| 1961-1966 | Entomology Research Advisor to Ministry of Agriculture, Government of Thailand, as part of U.S. A.I.D. program. |
| 1955-1961 | Staff Entomologist, Commander Naval Forces, Marianas, Guam. |
| 1954-1955 | Entomologist, Guam Department of Agriculture, Agana, Guam. |

**Advisory Appointments**

Serves as Authorized Departmental Officer's Designated Representative for more than 20 Cooperative Agreements with Universities.

**Honors and Awards**
Full Member, Sigma Xi, 1952
Elected Fellow, Washington Academy of Science, 1972
Award for 'Outstanding Leadership' as Acting Research Leader, Veg. Lab., $1,000. 1989.
Elected to the Collegium of Distinguished Alumni of Boston University. June 1993. Research accomplishments were cited.

## 3. LIST OF PUBLICATIONS (1993-1996)

**Peer-Reviewed Journal Articles**
1. Nickle, W.R., W.J. Connick, Jr. and W.W. Cantelo. 1994. Effects of pesta-pelletized Steinernema carpocapsae (All) on western corn rootworms and Colorado potato beetles. J. Nematology 26: 249-250.
2. Domek, J.M. and W.W. Cantelo. 1995. Nutritional Composition of potato foliage. Journal of Agr. and Food Chemistry.
3. Sanford, L.L., J.M. Domek, W.W. Cantelo, R.S. Kobayashi, and S.L. Sinden. 1996. Mortality of potato leafhopper adults on synthetic diets containing seven glycoalkaloids synthesized in the foliage of various *Solanum* species. Am. Potat J. 73:79-88.

**Abstracts of Papers Presented at Scientific Meetings**
1. Cantelo, W.W., W.J.E. Potts, and L.L. Sanford. 1994. Comparing potato plant resistance to the Colorado potato beetle. Am. Potato J. 71:665.
2. Cantelo, W.W. and W.J.E. Potts. 1996. Dispersion of adult Colorado potato beetle. 1996. Poster presentation at the International Meeting on Plant Resistance to Insects. Savannah, GA.

**Linkages with Other Laboratories:**
**Jeffery Aldrich**, Research Entomologist, Insect Chemical Ecology Lab. Collaborates in designing programs to suppress Colorado beetle populations by the release of the spined soldier bug.

Name: **KENNETH L. DEAHL**

Title: **RESEARCH PLANT PATHOLOGIST**

CRIS Project No. **1275-21220-061-00D**

Title: **Mechanism of Disease and Pest Resistance in Major Vegetables**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objective**: Characterize the genetic and phenotypic diversity in populations of *Phytophthora infestans* in the U.S.

**Accomplishment**: In order to develop more effective control strategies for late blight disease management, we have attempted to characterize the genetic and phenotypic variation in various populations of *Phytophthora infestans* in the United States. Although mating type changes provided the first suggestion of major modifications in *P. infestans* populations, variations in metalaxyl sensitivity also indicated dramatic changes in this pathogen. The results of nuclear DNA fingerprinting have permitted further resolution of genetic diversity in populations from different locations in the U.S.

Over 1,200 isolates of *P. infestans* were collected from 5 different geographic locations from 1989 to 1995 and subsequently characterized for mating type and metalaxyl resistance. Metalaxyl resistant isolates accounted for more than 75% of the total samples obtained from commercial fields after 1992. There was a parallel increase in isolation of $A^2$ mating types during this period. DNA fingerprinting of a small subpopulation of isolates from the ongoing matalaxyl-resistance monitoring project disclosed more than 12 different genotypes. The results indicate that genotypic diversity was variable among subpopulations, since some areas contained individuals with different genotypes, while other sites contained isolates of a single genotype. There were also significant differences in genotype frequencies between $A^1$ and $A^2$ isolates and between tomato and potato pathotypes.

**Plans**: Continue characterizing late blight population in the U.S. potato growing area using DNA fingerprinting probes, isozymes, DNA RFLPs and ribosomal DNA spacer sequences. Use these molecular techniques to detect genetic variation within and between pathotypes and study the relationships between the various molecular groupings that are identified and the extent to which these correlate with classical morphological groups.

**Objective**: Establish whether sexual mating is generating increasingly aggressive strains of *Phytophthora infestans* as a consequence of genetic recombination and new race formation in the U.S., Mexico, and Canada.

**Accomplishment**: The relative virulence of 14 isolates of *Phytophthora infestans* from different geographic origins including the United States, Canada, and Mexico was evaluated on 12 popular U.S. potato cultivars under controlled environmental conditions. The response of potato cultivars tested to the late blight disease caused by this fungus was quantitative rather than qualitative. No

hypersensitive symptoms were observed in any of the cultivars with any of the 14 isolates. A comparison of the *in vitro* response of the test strains isolated from different hosts revealed a high degree of diversity in response to metalaxyl and that increased resistance was directly correlated with greater virulence *in vivo*. Highly significant cultivar, isolate, and cultivar x isolate effects were observed, indicating a differential host-pathogen interaction. Significant differences in virulence among the isolates tested were found but were not dependent on the country of origin. Expression of age-related resistance to late blight was more apparent in potato stems than in potato leaves.
**Plans**: Continue to study the sexual cycle of the fungus in an effort to establish whether sexual progeny from putative hybrids retain the phenotype of escalating virulence.

**Objective**: A rapid method for specific detection of *Phytophthora infestans* mating types infecting potatoes is desirable for accurate determination of seed room, seedlot and field infection with late blight.
**Accomplishment**: The development of a rapid and precise assay for the identification of specific mating types of the fungus *Phytophthora infestans*, which causes potato late blight disease, could be invaluable to potato growers when decisions in disease management and prevention are continent upon genotypic traits. In an effort to differentiate the two mating types of *P. infestans* a modified Anchored Polymerase Chain Reaction (PCR) was used to generate DNA fragments from the ribosomal DNA region for which sequence information was unavailable. The procedure, random-primed/anchored-PCR (RPA-PCR) couples a primer of known nucleotide sequence with a random primer for the selective amplification of segments that are adjacent to the anchored primer. A primer complementary to a region of the ribosomal DNA (rDNA) internal transcribed spacer (ITS) sequence that is specific for the genus *Phytophthora* was used as the anchor primer in this study. The combination of primer UBC413 (80% CC random 10-mer) and the *Phytophthora* genus primer yielded a 175 bp fragment that was specific for the Al mating of *P. infestans*. The Al specific fragment resisted increases in temperature and reductions in annealing and extension times. The Al mating type specific fragment could be amplified from as little as 1 pg of template DNA and could be detected in both infected potato leaves and tubers.
**Plans**: Continue sequencing the major genotypes of *P. infestans* and develop species specific primers to amplify the pathogen DNA from infected potato leaves and tubers. Test the *P. infestans* specific primers on other major species of *Phytophthora*.

## 2. CURRICULUM VITAE

**Educational Background**
A.B., in Biology and General Science, Fairmont State College
M.S., in Plant Pathology, Agri. Microbiology, West Virginia University
Ph.D., in Plant Pathology and Plant Physiology, West Virginia University

**Post-graduate Employment History**
1971- present Research Plant Pathology, USDA:ARS : Potato Investigations/Vegetable Laboratory, Beltsville, Maryland

**Society Offices Held**
Member, American Mushroom Institute
Member, American Society for Microbiology
American Phytopathological Society
President, Potomac Division, 1993-1994.
Member, including Potomac Division
Member, Mycological Society of America
Member, Potato Association of America
Member, Society of Industrial Microbiology
Fellow, Washington Academy of Sciences

**Advisory Appointments**
U.S. representative and member of Executive Board, PICTIPAPA --International Late Blight Cooperative Project
U.S. representative for potato disease research on AID-funded, IPM initiative with scientist from central and eastern Europe.
Member of Board of Managers, Washington Academy of Science.
ADODR on eight potato projects with investigators in the United States. 1993-present.

**Awards and Grants**
Awarded a CIBA-Geigy Trust Fund for developing tests and monitoring fungicide insensitivity.
Co-recipient of a research grant ($25,000/year for three years) from the Irish government to study late blight in Mexico with Dr. Antonio Rivera Pená of the Metapec Research Center.
Awarded ARS Administrator's Postdoctoral associateship 1995.
USDA Certificates of Merit, 1994(1), 1995(3).

**3. PUBLICATIONS (1993-1996)**

**Peer-Reviewed Journal Articles**
1. Deahl, K.L., S.L. Sinden, and R.J. Young. 1993. Evaluation of wild tuber-bearing *Solanum* accessions for foliar glycoalkaloid level and composition. Am. Potato J.70:61-69.
2. DeahI, K.L., S.P. DeMuth, G.Pelter, and D.J. Ormrod. 1993. First report of resistance of *Phytophthora infestans* to metalaxyl in eastern Washington and British Columbia Canada. Plant Diseases/Notes. Plant Disease. 77:429.
3. DeahI, K.L., D.A. Inglis, and S.P. DeMuth. 1993. Testing for resistance to metalaxyl in *P. infestans* isolates from Northwestern Washington. Am. Potato J. 70:779-795.
4. Fry, W.B., S.B. Goodwin, K.L. Deahl, J.M. Matuszak, A. Drenth, P.W. Tooley, and L.J. Spielman. 1993. Historical and recent migration of *Phytophthora infestans.* Plant Disease. 77:653-661.

5. Goodwin, S. B., Cohen, B. A., Deahl, K. L. & Fry, W. E. 1994. Migration from northern Mexico as the probable cause of recent genetic changes in populations *of Phytophthora infestans* in the United States and Canada. *Phytopathology* 84:553-558.
6. Sanford, L.L., K.L. Deahl, and S.L. Sinden. 1994. Glycoalkaloid content in foliage of hybrid and backcross populations from a *Solanum tuberosum x S. chacoense* cross. Am. Potato J. 71:225-236.
7. Deahl, K.L., S.P. DeMuth, and A. Rivera-Pená. 1995. Occurrence of mating types and metalaxyl resistance in North American population of *Phytophthora infestans.* Am.Potato J. 72:35-49.
8. Deahl, K.L. and D.A. Inglis. 1995. Occurence of Metalaxyl-insensitive *Phytophthora infestans* on *Solanum sarachoides* in Northwestern Washington. Plant Disease. 79:540.
9. Sanford, L.L., K.L. Deahl, S.L. Sinden, and R.S. Kobayashi. 1995. Glycoalkaloid content in tubers of hybrid and backcross populations from a *Solanum tuberosum x S. chacoense* cross. Am. Potato J. 72:261-272.
10. Goodwin, S.B., B.A. Cohen, K.L. Deahl, D.A. Inglis, and W.E. Fry. 1996. Recent genetic changes in populations of *Phytophthora infestans* in the United States and Canada were probably caused by migration from northern Mexico. Plant Disease 77: In press.
11. Sanford, L.L., R.S. Kobayashi, K.L. Deahl, and S.L. Sinden, 1996. Segregation of leptines and other glycoalkaloids in *Solanum tuberosum* (4x) x *S. chacoense* (4x) crosses. Am. Potato J. 73:21-33.

**Other Significant Publications**

1. DeahI, K.L., S.P. DeMuth, and W.E. Fry. 1995. Genetic and phenotypic diversity in populations of *Phytophthora infestans* in the United States. Proceeding *Phytopathology* 150 conference, Dublin, Ireland. Sept. 10-16.
2. Deahl, K.L. 1995. Potato tubers role in late blight disease complex. Proceeding National Potato Council Seed Seminar. Rapid City, SD. Nov. 30-Dec. 2.

Sinden, S.L. and K.L. Deahl. Alkaloids. Diseases Caused by Toxic Plants, Toxic Marine Animals, and Poisonous Chemicals. In Hui, Y. H. (ed.) Food Borne Disease Handbook, Vol. III, Marcel Dekker, Inc., New York. p.227-261. 1994. (Invited Book Chapter)

**Abstracts of Papers Presented at Scientific Meetings**

1. Deahl, K.L., S.P. DeMuth, and A. Rivera Pená. 1993 Occurence of Metalaxyl resistance in North American populations of *Phytophthora infestans*. Am. Potato J. 70:806.
2. Deahl, K.L. and S.P. DeMuth. 1994. $A^2$ mating type of *Phytophthora infestans*. Increased frequency of occurence. 71:668-669.
3. Deahl, K.L. and S.P. DeMuth. 1994. Characterization of populations of *Phytophthora infestans* strains from potato in the US. Proceeding of 5th International Mycological Congress Vancouver. British Columbia. Aug. 12-18. p. 1411-12.

**Linkages with Other Laboratories:**

**Juan Landeo**. Peru. CIP, International Potato Center. *P. infestans* isolates and mating types in South America.

**Lowell Black**. Taiwan. AVRDC, Asian Vegetable Research and Development Center. Characterization of Asian isolates of *P. infestans* from tomato.

Dr. **Hector Saldana**. Mexico. Late blight resistance in Mexican-US clones.

Dr. **Antonio Rivera-Pena.** Mexico. $A^2$ mating type isolation in wild species.

Dr. **Mateo Credena and Dr. Narvaez Morales.** Mexico. Exchange potato germplasm and international late blight testing.

Dr. **B. Platt**. Canada . $A^2$ strains of *P. infestans* isolations from eastern Canada.

Dr. **David Ormrod**. $A^2$ strains from western Canada.

Dr. **Ludwick Sujkowski**. Poland. Variability in virulence and racial patterns.

Dr. **Jerzy Pietkiewics**. Poland. $A^2$ isolates exchange.

Dr. **Olivier Provust**. France. Elicitor purification.

Dr. **Leontine Colon**. The Netherlands. Late blight resistance in wild species.

Dr. **R.J. Young**. West Virginia University, Morgantown, West Virginia. Resistance to late blight and potato pathogens.

Dr. **C. Brooks**. University of Maryland-Eastern Shore. Insect resistance/control.

Dr. **S.F. Osman**. USDA:ARS, Philadelphia, Pennsylvania. Alkaloid biochemistry and metabolism in plants.

Dr. **Jacyn Baker**. USDA:ARS, Beltsville, Maryland. Mechanism of resistance in plant disease.

Dr. **K.L. Poff**. Michigan State University, East Lansing, Michigan. Photobiology and photochemistry studies.

Dr. **Paul Tooley**. USDA:ARS, Frederick, Maryland. Oospore germination studies.

Dr. **Bill Fry.** Cornell University, Ithaca, New York. Nuclear DNA content and allozyme phenotypes in *P. infestans*.

Dr. **Debbie Inglis**. Washington State University, Mount Vernon, Washington. Metalaxyl resistance in potato and tomato.

Dr. **John Helgeson.** University of Wisconsin. ARS. Durable resistance, rapid screening, and pathotypes of *P. infestans*.

Dr. **Charles R. Brown.** USDA:ARS, Prosser, Washington. Wild germplasm in durable resistance studies.

Name: **ROBERT W. GOTH**

Title: **RESEARCH PLANT PATHOLOGIST**

CRIS Project No. **1275-21220-087-00D**

Title: **Development of Methodology for the Identification and Improvement of Disease Resistance in Potato and Solanum Germplasm**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objective:** Develop information and methodology required to detect, identify, evaluate, and characterize bacterial, fungal and viral pathogens and confer resistance to these pathogens in developing germplasm of potato and other vegetables.

**Accomplishments**: Discovered that *Erwinia carotovora ssp. atroseptica* causes pepper soft rot. Established that potato cv BelRus is resistant to potato leafroll virus (PLRV). Used reverse transcription-polymerase chain reaction amplification to improve the detection of PLRV in potato tissue. Established that potato virus M was present in 85% of the cv Atlantic tubers grown in Maine. Developed protocols for long term storage of *Phytophthora phaseoli and Phytophthora infestans*. Established that infection by *Verticillium spp.* enhances, but is not essential for the development of the potato pinkeye disease. Also found that there was no consistent relationship between severity of Verticillium wilt and the incidence of pinkeye in segregating potato families, and that genes governing resistance to Verticillium wilt and pinkeye segregate independently. Established that cluster analyses of scab lesion type and percentage of tuber surface area infected data provided a means to quantitatively evaluate the scab reaction of new potato germplasm. Determined that breeding clone B6603-12 is immune to infection by PVS. Established that the scab resistance of two breeding selections, B0348-2 and B0339-l, clustered in the same group as the scab resistance standard cvs Krantz and Ontario. Released the Verticillium resistant russet clone B0l69-56. Identified the late blight resistance in clones B0718-3 and B0767-2. In the 1996 results from Hastings, FL., thirty-five potato clones, foreign and domestic, with reported late blight tolerance were evaluated for their reactions to the prevalent strains of *Phytophtora infestans*. Clones B0718-3 and B0767-2 were rated as the best.

**Plans:** Continue to improve methods to incorporate disease resistance into developing potato germplasm. Expand research efforts to include Fusarium dry rot and low temperature tolerant isolates of *Pseudomonas solanacearum*.

## 2. CURRICULUM VITAE

**Educational History**

Ph.D., University of Minnesota; plant pathology. 1961
M.S., University of Minnesota; plant pathology. 1958.
B.S., University of Wisconsin at Superior; biology. 1954.
Post Doctoral Studies, University of California Davis. 1966-67

**Post-graduate Employment History**

1967-Present Research Plant Pathologist, Vegetable Laboratory, USDA, ARS, Beltsville, MD
1961-1967 Research Plant Pathologist, Bean & Pea Investigations, Vegetable and Ornamental Branch, Beltsville, MD

**Society Offices Held**

American Phytopathological Society
- Member of the Public Responsibilities Committee, 1981-1988.
- Secretary-Treasurer Potomac Division, 1981-1984.
- Vice President, Potomac Division, 1984-85.
- President Potomac Division, 1985-86.
- Chair, Nominations Committee, Potomac Division, 1986-87.

Potato Association of America
- Director, Pathology Section, 1980.
- Secretary-Treasurer, Pathology Section, 1981.
- Vice-Chairman, Pathology Section, 1982.
- Chair, Pathology Section, 1983.
- Member U.S. Seed Potato Export Standards Committee, 1984-to present.
- Honorary Life Member, 1993.

**Advisory Appointments**

Proposal Reviewer, National Potato Council. 1988 to present.

ADODR on fifty-one Specific Cooperative Agreements at twelve Universities. 1988 to present.

ARS representative for the development of an international research program on late blight disease of potato of mutual interest to both the United States (ARS) and Mexico (INIFAP), 1991.

USDA Plant Pathologist for the Potato Germplasm committee (CGC), 1991 to present.

At the request of B. Glenn Lee, Deputy Administrator (APHIS), developed the biological information needed to resolve a potato seed problem between Agriculture Canada and the Dominican Republic regarding possible P*seudomonas solanacearum* infestation. January - March 1993.

**Honors and Awards:**

Gamma Sigma Delta, Gamma Alpha, Sigma Xi Societies,1960.

Honorary Life Member in the Potato Association of America, 1993.

Seed Researcher of the Year by the National Potato Council, 1993.

A Certificate of Merit and cash award for developing potato germplasm that has multi-genic resistance to potato late blight, 1995.

## 3. LIST OF PUBLICATIONS (1993-1996)

**Peer-reviewed Journal Articles**

1. Hadidi, A., M.S. Montasser, L. Levy, R.W. Goth, R.H. Converse, M.M. Madkukr and L.J. Skrzeckowski. 1993. Detection of potato leafroll and strawberry mild yellow-edge luteoviruses by reverse transcription-polymerase chain reaction amplification. Plant Disease 77: 595-601.
2. Goth, R.W., K.G. Haynes and D.R. Wilson. 1993. Relationship of Verticillium wilt with pink-eye of potato in Maine. Plant Disease 77:402-405.
3. Goth, R.W., K.G. Haynes and D.R. Wilson. 1993. Evaluation and characterization of advanced potato breeding clones for resistance to scab by cluster analysis. Plant Disease 77: 911-914.
4. Goth, R.W., K.G. Haynes, and D.R. Wilson. 1994. Independent segregation in potato for resistance to *Verticillium* wilt and pink-eye. Plant Disease 78:562-564.
5. Goth, R.W., K. G. Haynes, and D.R. Wilson. 1994. *Verticillium* wilt resistant germplasm: release of russet clone B0169-56. Am. Potato Journal 71: 735-742.
6. Weingartner, D.P., R. Mc Sorley and R.W. Goth. 1994. Management strategies for nematodes and soil-borne diseases in Subtropical Florida. Nematropica 23:233-245. 1994.
7. Goth, R.W., K.G. Haynes, R. J. Young, D.R. Wilson, and F.I. Lauer. 1995. Relative resistance of the potato cultivar Krantz to common scab caused by *Streptomyces scabies* as determined by cluster analysis. American Potato Journal 72: 505-511.
8. Stommel, J.R., R.W. Goth, and K.G. Haynes. 1996. Softrot decay of pepper (Capsicium annum) fruit by Erwinia spp. Plant Disease. Accepted for publication. April 23rd, 1996.

**Abstracts of Papers Presented at Scientific Meetings 1993-1996**

1. Goth, R.W., K.G. Haynes, D.R. Wilson, R.J. Young and W.E. Potts. 1993. Use of cluster analysis in the presence of genotype x environment interactions to characterize scab resistance in potato breeding clones. American Potato Journal 70:813.
2. Goth, R.W., K.G. Haynes, K.M.B. Frazier and D.L. Fleck. 1994. Evaluation of potato cultivars for resistance to Erwinia under high and low temperatures. American Potato Journal 71: 673.
3. Goth, R.W., K. G. Haynes and D.R. Wilson. 1994. Evaluations of potato breeding selections for resistance to late blight. American Potato Journal 71: 673.
4. Weingartner, D.P., K.G. Haynes, R.W. Goth and J.Meldrum. 1994. High levels of field resistance to corky ringspot disease exist in USDA segregating families B1136 and Bll76. American Potato Journal 71: 710.
5. Goth, R.W. E.W.Goins and K.G. Haynes. 1994. Reaction of potato cv BelRus to infection with potato leafroll virus. HortScience 29: 525.
6. Haynes, K.G., R.W. Goth and D.R. Wilson. 1994. Genotypic stability of potato clones for field resistance to Verticillium wilt in Maine. American Potato Journal 71:676-677.
7. Stommel, J.R., R.W. Goth and K.G. Haynes. 1995. A technique for inoculating pepper fruits withthe soft rot pathogen, *Erwinia carotovora.* HortScience 29:567.
8. Goth, R.W. and K.G. Haynes. 1995. Field plot testing of potato germplasm for late blight resistance. American Potato Journal 72.

**Linkages with Other Laboratories:**

**R. Loria**, Cornell University, Ithaca, NY. Determine correlations of thaxtomin reaction on tuber scab development of tetraploid *Solanum tuberosum* populations.

**D.P. Weingartner**, University of Florida, Hastings, FL. Evaluations of Solanum germplasm for reaction to tobacco rattle virus, the causal agent of corky ringspot of potato, and determine the effects of infections by *Pseudomonas solanacearum*, the causal organism of bacterial wilt, on the tuber yield, and other horticultural characteristics of advanced breeding clones and popular fresh market cultivars.

**E.E.Banttari, F.I. Lauer, N.A. Anderson**, University of Minnesota. St. Paul, MN. Evaluation of monoclonal antibody (Mab) based indirect competitive ELISA for measuring stem and tuber colonization of potato breeding lines by *Verticillium spp.*

**Alan Henn**, New England Soil and Water Laboratory, Orono, Maine. Cooperative studies on the interrelationships of nematodes and *Verticillium spp.*

Name: **KATHLEEN G. HAYNES**

Title: **RESEARCH PLANT GENETICIST**

CRIS Project No. **1275-21000-109-00D**

Title: **Breeding Potatoes for Disease and Insect Resistance, Processing and Fresh Market**

CRIS Project No. **1275-21000-106-00D**

Title: **Multiplication and Evaluation of Potato Breeding Selections for Yield, Quality, Disease Resistance, and Stress**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objective:** Develop improved pest-resistant germplasm and cultivars.
**Accomplishments:** More than a thousand crosses were made between disease resistant parents and commercial quality parents to study the inheritance of disease resistance, to enhance the germplasm base for disease resistance, and to develop new cultivars with improved disease resistances. Disease resistances in these crosses focused mainly on late blight, early blight, Verticillium wilt, scab, soft rot, corky ringspot, and bacterial wilt. Found that additive gene effects are important in bacterial wilt resistance in Tuberosum. Showed that resistance to Verticillium wilt and the pinkeye disease segregate independently in Tuberosum. A russet-skinned Verticillium wilt resistant clone was released to breeders. Showed that Verticillium wilt significantly reduced tuber specific gravity in susceptible cultivars, but had no effect on specific gravity in resistant cultivars. Developed a method to quantify the reaction of clonal material to scab that allowed us to classify the relative susceptibility of a clone, and, using this method, we demonstrated the superior scab resistance of 'Krantz', a new cultivar from the Minnesota breeding program. Investigated the statistical assumptions underlying various response variables for evaluating soft rot resistance and made recommendations as to the 'best' response variable to measure to quantify resistance to soft rot.
**Plans:** Inheritance studies are currently underway for resistance to scab at both the tetraploid and diploid level, for resistance to early blight, and for resistance to corky ringspot. The correlation of glycoalkaloid production with resistance to late blight in a population with horizontal resistance will be investigated. We are also going to investigate the possible role of phytoalexins in late blight resistance in a diploid population. Advanced clonal selections will continue to be tested for the effect of Verticillium wilt on yield, specific gravity and processing ability. Clonal selections from wild species with resistance to silver scurf, soft rot or late blight will be intercrossed with adapted materials to improve the germplasm base for resistance to these diseases.

**Objective:** Develop improved germplasm and cultivars for processing directly out of cold storage.
**Accomplishments:** Developed and tested several hundred selections for processing directly out of cold storage. Five round, white-skinned selections processed into acceptable color chips after four months of storage at 45F and also reconditioned well after four months of 40F storage: B0178-34, B0766-3, B0585-5, B0564-9 and B1093-2. Two oblong, russet-skinned selections processed into acceptable color and texture fries after three months of 45F storage: B9922-11 and B1004-8. Release notices for B0178-34 and B9922-11 are being prepared for fall 1996 release. The other selections mentioned above are currently in regional trials. Intercrossed selections that processed directly out of cold storage to improve the population. Showed that additive genetic, non-additive genetic, and genotype x environmental variation occur in roughly equal proportions in a diploid high specific gravity population.
**Plans:** Continue testing advanced selections for processing ability directly out of cold storage and work with growers to increase seed availability. Utilize two diploid species (*S. phureja* and *S. raphanifolium*) with processing ability out of cold storage to expand the germplasm base of tetraploid potatoes. Improve *S. phureja* and *S. raphanifolium* populations *per se* and investigate their combining ability with each other.

**Objective:** Enhance germplasm for specific characteristics relating to pest resistance, yield, environmental stress, human nutrition, and consumer acceptance.
**Accomplishments:** Developed a sampling strategy to determine the intensity of yellow-flesh tuber color and preserve the statistical sensitivity of comparisons between selections while reducing the amount of testing involved by one-half. Found that genotype x environment interactions on yellow-flesh intensity were very small. Showed that variation for incidence and severity of internal heat necrosis is 86-88% genetic in nature. Found that progeny from 4x-2x crosses were extemely female fertile, but had very poor pollen fertility.
**Plans:** Continue to use diploid yellow-flesh species in breeding for improved yellow-flesh cultivars. Continue to evaluate a segregating population for susceptibility to internal heat necrosis. Through 4x-2x crosses introduce additional high specific gravity germplasm to the Tuberosum base, and screen this germplasm for susceptibility to heat necrosis. Continue breeding efforts for red-skinned and russet-skinned potatoes for the eastern U.S. Evaluate complex hybrid populations involving different levels of species for yield and processing traits.

**Objective:** Develop statistical genetic models for some of the new breeding strategies.
**Accomplishments:** Estimated the coefficient of double reduction for several isozyme loci based on segregation patterns. Showed how it was theoretically possible for haploid Tuberosum to be more inbred than the tetraploid Tuberosum from which it was extracted. Showed that when the frequency of single exchange tetrads in the diploid parent was less than or equal to 2/3, the inbreeding in a derived tetraploid from a tetraploid x diploid cross would be less when the diploid parent produced 2n pollen by a first division restitution mechanism than by a second division restitution mechanism.
**Plans:** Continue genetic modelling work for interploidy hybridizations.

## 2. CURRICULUM VITAE

**Educational History**

Ph.D., Plant Breeding, North Carolina State University, Raleigh, NC. 1986
M.St., Statistics, North Carolina State University, Raleigh, NC. 1985
M.S., Plant Breeding, North Carolina State University, Raleigh, NC. 1981
B.S., LeMoyne College, Syracuse, NY. 1978

**Post-graduate Employment History**

1987-Present Research Plant Geneticist, Vegetable Laboratory, USDA, ARS, Beltsville, MD

**Society Offices Held**

NE-107 Regional Project
- Voting Member, 1988-present
- Chair, Rewrite Committee, 1996
- Chair, 1995
- Vice-chair, 1994
- Secretary, 1993

Breeding and Genetics Section of the Potato Association of America (PAA)
- Chair, 1992
- Vice-chair, 1991
- Secretary, 1990

Potato Association of America
- Member of Finance Committee, 1990-present
- Member of Graduate Student Awards Committee, 1996

**Advisory Appointments**

- Participated in the Potato Late Blight Disease Workshop, Beltsville, MD, 1994.
- Participated in the Potato Late Blight Resistance Meeting, Chicago, IL, 1994.
- Participated in the Potato Late Blight Research Conference, Beltsville, MD 1995.
- Member of the Maine Potato Variety Development Committee, 1989-present.
- Proposal reviewer, National Potato Council Funds, 1990-1992.
- ADODR for eight specific cooperative agreements on grants with universities, 1990-present.
- ADODR on an 1890 Land-Grant Cooperative Research Project, 1988-1989.
- Hosted a Peace Fellowship visiting scientist from Egypt, 1989.
- Serve as lead cooperating scientist on a PL-ARS Project, 1993- present.
- Serve as a collaborating scientist on a USAID Grant in Uganda, 1993-1995.

**Awards**

- Gamma Sigma Delta, 1980
- Sigma Xi, 1986
- USDA/ARS Performance Award, 1991, 1992, 1995

## 3. LIST OF PUBLICATIONS(1993-1996)

**Peer Reviewed Journal Articles**

1. Haynes, K.G. and D.S. Douches. 1993. Estimation of the coefficient of double reduction in the cultivated tetraploid potato. Theor. Appl. Gen. 85:857-862.
2. Goth, R.W., K.G. Haynes and D.R. Wilson. 1993. Relationship of Verticillium wilt with pink-eye of potato in Maine. Plant Disease 77:402-405.
3. Haynes, K.G. 1993. Some aspects of inbreeding in haploids of tetraploid *Solanum tuberosum* L. Am. Potato J. 70:339-344.
4. Haynes, K.G. and W.E. Potts. 1993. Minimizing inbreeding in tetraploids derived through sexual polyploidization. Am. Potato J. 70:617-624.
5. Goth,R.W., K.G. Haynes and D.R. Wilson. 1993. Evaluation and characterization of advanced potato breeding clones for resistance to scab by cluster analysis. Plant Disease 77:911-914.
6. Stommel, J.R. and K.G. Haynes. 1993. Genetic control of fruit sugar accumulation in a *Lycopersicon esculentum* x *L. hirsutum* cross. J. Am. Soc. Hort. Sci. 118:859-863.
7. Abdul-Baki, A.A. and K.G. Haynes. 1993. Male fertility of derived tetraploids of *Solanum tuberosum* from groups Tuberosum x Phureja-Stenotomum. Am. Potato J. 70:885-895.
8. Goth, R.W., K.G. Haynes and D.R. Wilson. 1994. Independent segregation in potato for resistance to Verticillium wilt and pink-eye. Plant Disease 78:562-564.
9. Haynes, K.G., W.E. Potts, J.L. Chittams and D.L. Fleck. 1994. Determining yellow-flesh intensity in potatoes. J. Am. Soc. Hort. Sci. 119:1057-1059.
10. Stommel, J.R. and K.G. Haynes. 1994. Inheritance of beta carotene content in the wild tomato species *Lycopersicon cheesmanii*. J. Heredity 85:401-404.
11. Goth, R.W., K.G. Haynes and D.R. Wilson. 1994. Verticillium wilt resistant germplasm: release of russet clone B0169-56. Am. Potato J. 71:735-742.
12. Haynes, K.G., D.R. Wilson and M.S. Kang. 1995. Genotype x environment interactions for specific gravity in diploid potatoes. Crop Science 35:977-981.
13. Goth, R.W., K.G. Haynes, R.J. Young, D.R. Wilson, and F.I. Lauer. 1995. Relative resistance of the potato cultivar Krantz to common scab caused by *Streptomyces scabies* as determined by cluster analysis. Am. Potato J. 72:505-511.
14. Haynes, K.G., J.B. Sieczka, M.R. Henninger and D.L. Fleck. 1996. Clone x environment interactions for yellow-flesh intensity in tetraploid potatoes. J. Am. Soc. Hort. Sci. 121:175-177.

**Abstracts of Papers Presented at Scientific Meetings**

1. Haynes, K.G. and S.L. Sinden.1993. Evaluation of yellow-flesh potato clones. HortSci. 28:464.
2. Goth, R.W., K.G. Haynes, D.R. Wilson, R.J. Young and W.E. Potts. 1993. Use of cluster analysis in the presence of genotype x environment interactions to characterize scab resistance in potato breeding clones. Am. Potato J. 70:813.
3. Haynes, K.G. and A.A. Abdul-Baki. 1993. Male fertility of derived tetraploids of *Solanum tuberosum* from Groups Tuberosum x Phureja-Stenotomum. Am. Potato J. 70:814-815.

4. Haynes, K.G. and D.R. Wilson. 1993. Estimate of broadsense heritability for specific gravity in a diploid hybrid population of *Solanum tuberosum* Groups Phureja and Stenotomum. Am. Potato J. 70:815.
5. Goth, R.W., E.W. Goins and K.G. Haynes. 1994. Reaction of potato cv. BelRus to infection with potato leafroll virus. HortScience 29:525.
6. Stommel, J.R., R.W. Goth and K.G. Haynes. 1994. A technique for inoculating pepper fruits with the soft rot pathogen, Erwinia carotovora. HortScience 29:567.
7. Goth, R.W., K.G. Haynes, K.M.B. Frazier and D.L. Fleck. 1994. Evaluation of potato cultivars for resistance to *Erwinia* under high and low temperatures. Am. Potato J. 71:673.
8. Goth, R.W., K.G. Haynes and D.R. Wilson. 1994. Evaluation of potato breeding selections for resistance to late blight. Am. Potato J. 71:673.
9. Haynes, K.G., R.W. Goth and D.R. Wilson. 1994. Genotypic stability of potato clones for field resistance to verticillium wilt in Maine. Am. Potato J. 71:676.
10. Henninger, M.R., K.G. Haynes and S.B. Sterrett. 1994. Genetic components of variance for internal heat necrosis in clonally propagated potatoes. Am. Potato J. 71:677.
11. Weingartner, D.P., K.G. Haynes, R.W. Goth and J. Meldrum. 1994. High levels of field resistance to corky ringspot disease exist in USDA segregating families B1136 and B1176. Am. Potato J. 71:709.
12. Haynes, K.G., J.B. Sieczka, M.R. Henninger and D.L. Fleck. 1995. Genotype x environment interactions for yellow-flesh intensity in tetraploid potatoes grown at three northeastern locations. Am. Potato J. 72:628-629.
13. Kobayashi, R.S., K.G. Haynes and S.L. Sinden. 1995. Tuber glycoalkaloid content in potato varieties grown at eight locations. Am. Potato J. 72:635.
14. Goth, R.W. and K.G. Haynes. 1995. Field plot testing of developing potato germplasm for late blight resistance. Am. Potato J. 72:622.

**Other Significant Publications**

1. Haynes, K.G. 1993. Statistics in a potato breeding program. Biometrics Bulletin 10(2):25-26.
2. Haynes, K.G. 1995. Review of *Potato Genetics*. J.E. Bradshaw and G.R. Mackay (eds.) CAB International, Wallingford, UK, 1994. 522 p. Field Crops Research 40:129-130 (Invited Book Review).

**Linkages with Other Laboratories:**

**Barbara Christ**, Pennsylvania State University, University Park, PA. Cooperates on inheritance studies on early blight resistance, late blight screening of diploid and wild species hybrids, and development of cold temperature storage potatoes for processing.
**D. Peter Weingartner**, University of Florida, Hastings, FL. Cooperates on inheritance studies on resistance to bacterial wilt, brown rot, and corky ringspot.
**Rosemary Loria**, Cornell University, Ithaca, NY. Cooperates on determining relationship of thaxtomins to scab resistance.
**Susan McCormick**, USDA/ARS, Peoria, IL. Cooperates on role of phytoalexins in late blight resistance.

**Neil Anderson**, University of Minnesota, St. Paul, MN. Cooperates on inheritance studies on resistance to common scab.
**Melvin Henninger**, Rutgers University, New Brunswick, NJ. Cooperates on inheritance of resistance to internal heat necrosis and relationship between susceptibility to heat necrosis and high specific gravity.
**Susan Sterrett**, Virginia Polytechnic Institute and State University, Painter, VA. Cooperates on inheritance of resistance to internal heat necrosis and relationship between susceptibility to heat necrosis and high specific gravity.
**Donald Halseth**, Cornell University, Ithaca, NY. Cooperates on development of cold temperature storage potatoes for processing.
**Alvin Reeves**, University of Maine, Presque Isle, ME. Cooperates on determining population parameters for various interploidy derived populations.
**Joseph Sieczka**, Cornell University, Riverhead, NY. Cooperates on genetic studies involving yellow-flesh potatoes.
**Gregory Porter**, University of Maine, Orono, ME. Develops production management recommendations for selections about to be named and released from our breeding program.

Name: **LIND L. SANFORD**

Title: **RESEARCH GENETICIST**

CRIS Project No. **1275-21000-109-00D**

Title: **Breeding Potatoes for Disease and Insect Resistance, Processing and Fresh Market**

CRIS Project No. **1275-21000-085-00D**

Title: **Evaluation, Enhancement, and Release of Pest and Disease Resistant Potato and Tomato Germplasm**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objective:** Introgress gene(s) for the synthesis of the glycoalkaloid leptine (a Colorado potato beetle resistance factor) from *S. chacoense* into adapted *S. tuberosum* germplasm.
**Accomplishments:** The chromosome number of a *chacoense* clone that synthesizes a high concentration of foliage leptine was doubled from 24 to 48, improving considerably its crossability with tetraploid *tuberosum* germplasm. Over 500 tetraploid $F_1$ hybrids between these two species were tested for foliage leptine content. All of the hybrids synthesized some leptine, segregating over a wide range of concentrations. The maximum foliage concentration in a hybrid was 0.369% fresh weight compared with the concentration in the *chacoense* species of 1.63%. Leptine was not found in the tubers of *chacoense* and was not found in the tubers of any hybrid. Only the common alkaloids solanine and chaconine were present in tubers. However, the tubers of all hybrids had glycoalkaloid concentrations higher than 0.02%, the commonly accepted upper level. This was in part the result of the small tuber size of the hybrids. A selected group of $F_1$ hybrids were successfully selfed to form $F_2$ hybrids and also were crossed back to *tuberosum* genotypes.
**Plans:** $F_2$ hybrids and backcross genotypes will be tested for leptine content. Selection and crossing will continue for the introgression of genes for leptine synthesis into adapted *tuberosum* germplasm. Select genotypes with high percentages of leptine in foliage, but with low levels of other glycoalkaloids in tubers.

**Objective:** Determine the inheritance pattern of leptine synthesis in *S. chacoense*.
**Accomplishments:** Reciprocal crosses were made between two *chacoense* genotypes, one in which the foliage content of glycoalkaloids consists of 90% leptine, and the other in which the content consists of solanine and chaconine with only a trace of leptine. The foliage leptine contents of a sample of $F_1$ genotypes were measured. Crosses were made among a selected sample of the $F_1$ , and the $F_1$ were backcrossed to both parents. Leptine content was measured in a sample of $F_2$ and backcross genotypes. The segregation ratios of leptine synthesizing and non-synthezing $F_1$ genotypes were different in the reciprocal crosses. Preliminary analysis of the

leptine segregation in $F_2$ and backcross families indicate that at least three genes are involved in controlling the synthesis of leptine . Nearly all of the genotypes in these families showed the presence of at least trace amounts of leptine, but there were clear segregating class differences approximating the proportions found in the parents. There is some indication that the proportion of leptinine (a precursor of leptine) occurring in the leaves affects leptine non-synthesis to synthesis ratios. The concentrations of leptine found within families appeared to be continuous and therefore may be controlled by polygenes.
**Plans:** Cross certain $F_2$'s to determine their possible genotypes, and the number of genes and their genetic states in controlling leptine synthesis. Study possible causes of the reciprocal differences.

**Objective:** Evaluate the effects of glycoalkaloids on the feeding, reproduction, and mortality of potato leafhoppers and Colorado potato beetles.
**Accomplishments:** High levels of resistance to foliage damage caused by feeding of adult and larval stages of Colorado potato beetle were measured in field tests of tetraploid hybrids from *S. tuberosum x chacoense* crosses. The foliage leptine concentrations of these hybrids ranged from 0.06 % to 0.34%. The proportion of the glycoalkaloids in the hybrids' foliage that was leptine ranged from 20% to 60%. The level of foliage damage was moderately correlated with both leptine concentration and proportion.

The mortality of adult potato leafhoppers was measured on artificial diets containing various glycoalkaloids that are synthesized in several *Solanum* species. Although the leptines are known to strongly deter feeding of Colorado potato beetle compared with the deterrence caused by the common glycoalkaloid solanine, the leafhopper mortality caused by leptines was no greater than that caused by solanine. Tomatine, found in several wild species, caused the greatest mortality. Chaconine, the other common potato glycoalkaloid, caused significantly more mortality than did solanine. About two-thirds of the glycoalkaloids found in the foliage of the commercial potato species is chaconine. The positive correlation between total foliage glycoalkaloid content and infestation level of leafhoppers that has been found in *tuberosum* breeding populations is likely caused by this glycoalkaloid.
**Plans:** Field-test hybrid and backcross interspecific germplasm that synthesize foliage leptine for resistance to Colorado potato beetle. In field and laboratory tests evaluate the concentration and proportion of leptine in foliage that is needed for moderate to high levels of resistance.

**Objective:** Introgress gene(s) for the formation 'B' type glandular trichome on leaves (from *S. berthaultii)* into adapted *S. tuberosum* germplasm as a resistance factor to potato leafhopper.
**Accomplishments:** Advanced interspecific hybrids have been selected with moderate densities of type 'B' trichomes that exhibit resistance to infestation by potato leafhoppers and have good tuber yield and type. The hybrids with the highest density of 'B' trichomes and greatest resistance to leafhopper tend to have vine and tuber characteristics of the *berthaultii* species. When these hybrids were crossed back to *tuberosum* germplasm for further improvment of these traits, type 'B' trichomes were not formed. So far sib-mating among backcross genotypes to break possible linkages between *tuberosum* genes and *berthaultii* genes controlling glandular trichomes has not been succesful in stimulating the formation of type 'B' trichomes in these populations.

**Plans:** Continue selection for 'B' trichomes and improved horticultural traits in hybrid and backcross populations. There is a report of successfully stimulating the expression of 'B' trichomes in backcross genotypes by utilizing somaclonal variation techniques. Explants from a sample of backcross genotypes with improved horticultural traits will be regenerated in tissue culture to generate somaclonal variation. The regenerated materials will be screened for the expression of 'B' trichomes.

## 2. CURRICULUM VITAE

**Educational History**
Ph.D., Horticulture, Iowa State University, Ames, IA. 1960
B.S., Horticulture, Iowa State University, Ames, IA. 1953

**Post-graduate Employment History**
1965-Present Research Geneticist, Vegetable Laboratory, USDA, ARS, Beltsville, MD
1960-1965 Research Geneticist, USDA, ARS, Aberdeen, ID

**Society Offices Held**
Potato Association of America
Member, 1963-1965, Potato Handbook Committee.
Member, 1961-present, Breeding and Genetics Section.
Chairman, 1971-1973, Breeding and Genetics Section.
Member, 1985-1987, Journal Review Committee.
Chairman, 1988-1993, Journal Review Committee.

**Editorial Board Appointments**
American Potato Journal
Member, 1973-1984, Editorial Committee.
Associate Editor, 1985-1987.
Senior Editor, 1988-present.

**Advisory Appointments**
Panelist for RPES Committee, 1975-1976.
Proposal Reviewer, National Potato Council, 1981.
CPB Testing Protocol, IR-1 Committee, 1982.
CPB Management Protocol Committee, National Potato Council, 1986.
Proposal Reviewer, National Potato Council, 1993-1995.
ADODR on Specific Cooperative Agreements with Cornell University and North Dakota State University for Developing CPB Resistant Potatoes, 1991-1993.

**Awards**
Gamma Sigma Delta, 1953.
Sigma Xi, 1962.

## 3. LIST OF PUBLICATIONS (1993-1996)

**Peer-Reviewed Journal Articles**

1. Sanford, L.L., K.L. Deahl, and S.L. Sinden. 1994. Glycoalkaloid content in foliage of hybrid and backcross populations from a *Solanum tuberosum x S. chacoense* cross. Am. Potato J. 71:225-236.
2. Sanford, L.L., K.L. Deahl, S.L. Sinden, and R.S. Kobayashi. 1995. Glycoalkaloid content in tubers of hybrid and backcross populations from a *Solanum tuberosum x S. chacoense* cross. Am. Potato J. 72:261-272.
3. Sanford, L.L., R.S. Kobayashi, K.L. Deahl, and S.L. Sinden, 1996. Segregation of leptines and other glycoalkaloids in *Solanum tuberosum* (4x) x *S. chacoense* (4x) crosses. Am. Potato J. 73:21-33.
4. Sanford, L.L., J.M. Domek, W.W. Cantelo, R.S. Kobayashi, and S.L. Sinden. 1996. Mortality of potato leafhopper adults on synthetic diets containing seven glycoalkaloids synthesized in the foliage of various *Solanum* species. Am. Potato J. 73:79-88.

**Abstracts of Papers Presented at Scientific Meetings**

1. Sanford, L.L., K.L. Deahl, and S.L. Sinden. 1993. Glycoalkaloid content in foliage of hybrid and backcross populations from a *Solanum tuberousm x S. chacoense* cross. Am. Potato J. 70: 837.
2. Sinden, S.L., F.G. Perez, L.L. Sanford, and K.L. Deahl. 1993. Evaluation of some rapid methods of tuber glycoalkaloid (TGA) analysis. Am. Potato J. 70: 840.
3. Sanford, L.L., K.L. Deahl, S.L. Sinden, and R. Kobayashi. 1994. Glycoalkaloid content of tubers of hybrid and backcross populations from a *Solanum tuberosum x S. chacoense* cross. Am. Potato J. 71:697.
4. Kobayashi, R.S., S.L. Sinden, and L.L. Sanford. 1994. Effect of ploidy on foliar glycoalkaloid concentration and Colorado potato beetle resistance in *Solanum chacoense*. Am. Potato J. 71:680.
5. Cantelo, W.L., W.J.E. Potts, and L.L. Sanford. 1994. Comparing potato plant resistance to the Colorado potato beetle. Am. Potato J. 71:665.
6. Sanford, L.L., R.S. Kobayashi, K.L. Deahl, and S.L. Sinden. 1995. Segregation of the glycoalkaloid leptine in *Solanum tuberosum* (4x) x *S. chacoense* (4x) crosses. Am. Potato J. 72:651.

**Linkages with Other Laboratories:**

Dr. **John Bamberg**, Potato Introduction Station, Surgeon Bay, WI
Dr. **Robert Hanneman**, Jr., Department of Horticulture, University of Wisconsin, Madison, WI
Dr. **James Lorenzen**, Dept.of Horticulture & Forestry, North Dakota State U., Fargo, ND
Dr. **Shelly Jansky**, Dept. Of Biology, University of Wisconsin/Stevens Point, Stevens Point, WI
Dr. **David Douches**, Crop and Soil Sciences, Michigan State University, East Lansing, MI
Dr. **Richard Veilleux**, Dept. Horticulture, VPI & SU, Blacksburg, VA

Name: **JOHN R. STOMMEL**

Title: **RESEARCH PLANT GENETICIST**

CRIS Project No. **1275-21000-110**

Title: **Germplasm Enhancement of Solanaceous Fruit Crops**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objective:** Develop adapted tomato germplasm with increased levels of fruit soluble solids.
**Accomplishments:** Wild species of tomato were identified which contained high soluble solids levels and stored sucrose as the principle free sugar. Demonstrated that sucrose accumulation in tomato fruit was attributable to the lack of cleavage by sucrose hydrolyzing enzymes prior to storage. Genetic studies demonstrated that a single major gene displaying dominance for hexose sugar storage regulated sugar type in tomato fruit. The glucose to fructose ratio was shown to be quantitatively inherited. Populations are being developed to evaluate the contribution of sucrose to increased total sugar and solids levels. In cooperation with R. Shields, a molecular marker for the sugar storage allele, *sucr*, has been evaluated for its utility in screening these populations.
**Plans:** Marker assisted selection will be used to speed development of populations and breeding lines. Correlations between sucrose content and soluble solids will be determined in advanced large fruited populations.

**Objective:** Develop tomato germplasm with increased pigment content and improved nutritional quality via enhancement of fruit carotenoid profiles.
**Accomplishments:** Established that a single gene, dominant for a high level of beta-carotene, controls carotenoid content in the wild tomato species *L. cheesmanii*. Advanced fresh market and processing type breeding lines have been developed from crosses with this wild species and are being evaluated for release in conjunction with industry cooperators. These lines are high in the provitamin A carotenoid beta-carotene.
Near isogenic lines of tomato which differ for the presence of the high pigment (*hp*) allele are being utilized to identify molecular markers tightly linked to *hp*. This recessively inherited allele conditions increased levels of fruit carotenoids. Screening for RAPD markers in respective isolines and bulks from segregating populations developed for this work is in progress. Identification of tightly linked flanking markers will facilitate tracking this gene in breeding lines, help to eliminate deleterious alleles associated with *hp*, and speed progress in the development of elite lines.
**Plans:** Continue development of fresh market and processing type high beta-carotene tomato lines and high pigment materials. Incorporate markers identified for high pigment into a marker assisted selection program.

**Objective:** Develop improved disease resistant tomato and pepper germplasm.
**Accomplishments:** A number of tomato populations have been developed from crosses between a common susceptible parent and parents with divergent levels of anthracnose fruit rot resistance. These materials will be used to identify quantitative trait loci (QTL) for anthracnose resistance. The phenotypic data obtained from screening these materials for anthracnose resistance is presently being evaluated to characterize the genetic components contributing to anthracnose resistance.
In cooperation with S. Sinden, somatic hybrids between the pest resistant, non-tuber bearing species *Solanum ochranthum* and *Lycopersicon esculentum* were obtained. Approximately 50 of these somatic hybrids were grown to maturity and evaluated for ploidy level and pollen fertility. Continued introgression of desirable genes from *S. ochranthum* will be attempted with identified fertile tetraploid somatic hybrids.
In cooperation with J. Kaper (MPPL, retired), satellite transgenic tomato lines developed by J. Kaper for resistance to cucumber mosaic virus resistance are being evaluated in a three year APHIS approved field trial. The results obtained from the past two years of this trial demonstrate that satellite derived CMV resistance confers high levels of resistance under simulated epidemic conditions.
In cooperation with R. Goth, the reaction of a diverse range of pepper genotypes was evaluated for soft rot resistance. The influence of post-harvest storage temperature on the ability of different *Erwinia* species to cause soft rot of pepper was determined and the importance of *Erwinia carotovora* subsp. *atroseptica* in causing soft rot under cool conditions was described.
**Plans:** Identify molecular markers linked to QTL for anthracnose resistance in tomato. Develop a marker assisted selection program to facilitate incorporation of anthracnose resistance from wild relatives of tomato into adapted tomato germplasm.
Utilize fertile *S. ochranthum* + *L. esculentum* somatic hybrids to obtain backcross progeny with tomato and develop adapted lines with pest resistance genes from *S. ochranthum*.
Initiate a project to identify sources of improved septoria resistance in tomato and incorporate this resistance into adapted germplasm.

## 2. CURRICULUM VITAE

**Educational History**
Ph.D., Plant Breeding and Plant Genetics, University of Wisconsin, Madison, WI, 1989.
M.S., Plant Breeding and Plant Genetics, University of Wisconsin, Madison, WI, 1985.
B.S., Biology (Botany Emphasis), University of Wisconsin, Oshkosh, WI, 1982.

**Post-graduate Employment History**
1989-Present Research Geneticist, Vegetable Laboratory, USDA, ARS, Beltsville, MD.
1983-1989 Research Assistant, Dept. of Horticulture, Univ. of Wisconsin, Madison, WI.

**Society Offices Held**
Member, American Association for the Advancement of Science, 1986-present.
Member, American Society for Horticultural Science, 1989-present.
Member, Tomato Genetics Cooperative, 1989-present.

**Advisory Appointments**

Representative of USDA Tomato Crop Germplasm Committee, 1992-present.

Co-Chairman of the BARD competitive grants Field and Garden Crops review panel, 1994-present.

Committee member of the USAID competitive grants Tissue Culture review panel, 1990-1992.

Research advisor and graduate faculty committee member for Ms. Katherine Stephenson, Masters degree candidate, University of Maryland, Dept. of Horticulture. Thesis title: Protoplast Co-Culture and Whole Plant Grafting Systems for Production of Genetic Chimeras in *Lycopersicon* and Other *Solanaceous* Species. 1994-present.

ADODR for Specific Cooperative Agreement project entitled "Laboratory and Field Evaluation of *Lycopersicon* Germplasm Collections for Durable Resistance to Late Blight" with the University of California.

**Honors and Awards**

Sigma Xi, 1992.

Recipient of a Trust Fund granted by the H.J. Heinz Company, 1996.

Principal Investigator of a three year grant "Pilot Test of Satellite-Transgenic Tomato Resistance Against Cucumber Mosaic Virus: A Novel Biocontrol Approach", USDA Pilot Test Grants Program, 1993.

Recipient of USDA-ARS certificate of merit, Performance Award, 1992, 1993, 1995.

## 3. LIST OF PUBLICATIONS (1993-1996)

**Peer Reviewed Publications**

1. Stommel, J.R. and R.J. Griesbach. 1993. New ornamental *Capsicum* germplasm: Lines 90C40, 90C44, and 90C53. HortScience 28:858-859.
2. Stommel, J.R. and K.G. Haynes. 1993. Genetic control of fruit sugar accumulation in a cross of *Lycopersicon esculentum* x *L. hirsutum*. J. Amer. Soc. Hort. Sci. 118:859-863.
3. Stommel, J.R. and K.G. Haynes. 1994. Inheritance of beta-carotene content in the wild tomato species *Lycopersicon cheesmanii*. J. Heredity 85:401-404.
4. Abdul-Baki, A.A. and J.R. Stommel. 1995. Pollen viability and fruit set of heat-tolerant and -sensitive tomato genotypes under optimum and high temperature regimes. HortScience 30:115-117.
5. Abdul-Baki, A.A., J.R. Stommel, A.E. Watada, J.R. Teasdale, and R.D. Morse. 1996. Hairy vetch increases yield of processing tomatoes. HortScience (In press).
6. Kobayashi, R.S., J.R. Stommel, and S.L. Sinden. 1996. Somatic hybridization between *Solanum ochranthum* and *Lycopersicon esculentum*. Plant, Cell, Tissue and Organ Culture (In press).
7. Stommel, J.R., R.W. Goth, and K.G. Haynes. 1996. Soft rot decay of pepper (*Capsicum annuum*) fruit caused by *Erwinia* species. Plant Disease (Accepted for publication).

8. Stommel, J.R., G.R. Panta, A. Levi and L.J. Rowland. 1996. Effects of gelatin on the amplification reaction for generating randomly amplified polymorphic DNA. BioTechniques (submitted for publication).

**Other Significant Publications**

1. Stommel, J.R. 1993. *sucr*: Gene symbol for the reducing sugar vs. sucrose accumulation character in tomato fruit. Tomato Genet. Coop. Rep. 43:45-46.
2. Abdul-Baki, A.A., J.R. Stommel, and J.R. Teasdale. 1994. Evaluation of processing tomato varieties in a sustainable agricultural system using hairy vetch mulch. Proceedings of the 24th Ann. Mtg. Mid-Atlantic Vegetable Workers Conference, pp. 59-64.
3. Kobayashi, R.S., K.L. Deahl, J.R. Stommel, and S.L. Sinden. 1994. Evaluation of *Solanum ochranthum* as a potential source of late blight resistance. Tomato Genet. Coop. Rep. 44:15-16.
4. Abdul-Baki, A.A., J.R. Stommel, J.R. Teasdale, and R.W. Goth. 1995. Effect of hairy vetch and black polyethylene mulches on yield and disease reaction of processing tomatoes. Proc. 25th Annual Meeting of the Mid-Atlantic Vegetable Workers Conference.
5. Kobayashi, R.S., S.L. Sinden, and J.R. Stommel. 1996. Regeneration of *Solanum ochranthum* + *Lycopersicon esculentum* somatic hybrids. Book chapter for inclusion in Plant Protoplasts and Genetic Engineering, Vol. 7., Springer Verlag (In press).

**Abstracts of Papers Presented at Scientific Meetings**

1. Abdul-Baki, A. and J.R. Stommel. 1993. Pollen viability and fruit set of heat-tolerant and sensitive tomato genotypes under optimum and high-temperature regimes. HortScience 28:567.
2. Kobayashi, R., S.L. Sinden, and J.R. Stommel. 1993. Tissue and protoplast culture of *Solanum ochranthum*. HortScience 28:545.
3. Stommel, J.R. 1993. Inheritance of tomato fruit carotenoid content in populations derived from a cross of *Lycopersicon esculentum* x *L. cheesmanii*. HortScience 28:506.
4. Avni, A., N. Avidan, Y. Eshed, D. Zamir, B.A. Bailey, J.R. Stommel, and J.D. Anderson. 1994. The response of *Lycopersicon esculentum* to a fungal xylanase is controlled by a single dominant gene. Plant Physiol. 105:872.
5. Kobayashi, R.S., S.L. Sinden, and J.R. Stommel. 1994. Somatic hybridization between *Solanum ochranthum* and *Lycopersicon esculentum*. HortScience 29:465.
6. Stommel, J.R., R.W. Goth, and K.G. Haynes. 1994. A technique for inoculating pepper fruits with the soft rot pathogen, *Erwinia carotovora*. HortScience 29:567.
7. Stommel, J.R. 1994. Tomato fruit sugar composition: Impact on fruit quality. Tomato Breeders Roundtable Proceedings, North Carolina State University, pp. 11-12.
8. Stommel, J.R. 1995. Genetic improvement of crop plant nutritional value: Impact of plant biotechnology, C.E.S.T. Functional Nutrition Workshop Proceedings. Massachusetts Institute of Technology, p.26.
9. Wai, T., J.R. Stommel, M.E. Tousignant, and J.M. Kaper. 1995. Field test of satellite-transgenic tomato resistance against CMV. Phytopathology 85:1192.
10. Stommel, J.R., R.S. Kobayashi, and S.L. Sinden. 1995. Barriers to introgression into tomato of intergeneric fusion hybrids of *Solanum ochranthum* and tomato. HortScience 30:822.

11. Stommel, J.R., M.E. Tousignant, T. Wai, and J.M. Kaper. 1996. Efficacy of endogenous satellite expression to confer resistance to CMV in satellite transgenic tomato under field conditions. HortScience (In press).

**Linkages with Other Laboratories:**

Dr. **Richard Ozminkowski and** Dr. **Davy Emmatty**, H.J. Heinz Co., Bowling Green, OH and Stockton, CA. Collaborates in the development of processing tomato germplasm with resistance to anthracnose fruit rot and septoria, improved fruit pigmentation, and increased solids.

Dr. **Robert Shields**, Plant Breeding International, Cambridge, England. Collaborates in development of molecular marker assisted selection schemes for improving tomato fruit solids levels.

Dr. **Michael Kuehn**, Campbell Soup Company, Davis, CA. Collaborates in the development of tomato germplasm adapted for processing with improved nutritional quality.

Dr. **Mark Barineau**, Petoseed Co., Felda, FL. Collaborates in the development of improved fresh market tomato germplasm with improved nutritional quality and flavor.

Dr. **Randy Gardner**, North Carolina State University, Fletcher, NC. Collaborates in screening of tomato germplasm for resistance to late blight.

Dr. **Robert Griesbach**, Floral and Nursery Crops Research Unit, BARC. Collaborates in the development of ornamental pepper germplasm.

Name: **ROBERT F. WHITCOMB**

Title: **RESEARCH ENTOMOLOGIST**

CRIS Project No. **1275-21220-061-00D**

Title: **Mechanism of disease and pest resistance in major vegetables**

## 1. RESEARCH OBJECTIVES, ACCOMPLISHMENTS, AND PLANS

**Objectives, Accomplishments, and Plans, 1995-96**
**Objective:** Document pest occurrence and devise control strategies for alternative vegetable crop production systems that enhance the environment and that are healthy for the consumer.
**Plans:** Document differences in pest occurrence that are explained by differences in scale and geographic location; work with scientists and growers to develop control strategies that are appropriate for alternative production systems.

**Objective:** In collaboration with Farm Operations Branch, develop a set of sustainable meadows as lawn replacements to reduce FOB maintenance costs, and to serve as a model for lawn replacements in residences, institutions, and industrial grounds in the eastern Atlantic states.
**Accomplishment:** Since 1992, using seven different strategies for meadow establishment, 33 meadow systems, totalling more than 60 acres, have been established. Of these, 30 have promise of sustainability. FOB maintenance costs have been reduced, and the system has been described at a Native Plant workshop. Plant species richness has been determined for each meadow, and changes during the early, dynamic phase of meadow establishment have been recorded.
**Plans:** Plant species compositions of each meadow will be determined by monthly surveys in 1996, converted to diversity indices, and used in preparing manuscripts. Insects will be sampled by transect methods and Malaise trap sampling, identified, and used for quantitative analyses of insect species composition.

**Objective:** Document insect pest occurrence on a landscape level in reference to sustainable agriculture research field. Determine effect of architecture and species compositions of plant communities of noncanopied habitats (crop and noncrop) on pest occurrences.
**Accomplishment:** More than 100,000 insect specimens were collected from transects of crop and noncrop communities on a biweekly basis in 1993-4. In 1995, the meadow systems were added to the sampled plant communities.
**Plans:** In 1996, the specimens will be identified and entered into a database, from which they will enter SAS for multivariate analysis.

**Objectives, Accomplishments, and Plans, 1990-1995**
CRIS Project Number: 1275-22000-082-00D
Title: Mollicute and associated insect biology: Molecular approaches to pest insect and plant disease control.

**Objectives:** The specific objectives of this CRIS were: (1) Develop spiroplasma and achole plasma classifications documented by collections of representative types, with emphasis on new insect hosts, especially pest species. Characterize serotypes, describe new groups, subgroups, or species; (2) Develop principles of microbial ecology of mollicutes by field and laboratory experiments and observation of ecological roles in natural and laboratory ecosystems; (3) Assess ecology of candidate spiroplasmas and assist in development of molecular transformation systems for use in biocontrol of the Colorado Potato Beetle; (4) Develop molecular methods for classification of plant disease vectors; (5) Develop concepts of life history strategies of phloem-feeding cicadellids of field crops and natural open habitats by field and laboratory studies of cicadellid distribution, abundance, host specificity, interaction with host defense systems, phenology, dispersion and other escape mechanisms; and (6) Devise new approaches for management of homopterous pests and their habitats, with emphasis on integration with emerging methodology for sustainable agriculture of the Central Atlantic states.

**Accomplishments:** (1) A revised classification of spiroplasmas has been completed. Eight new groups will be described; all of these groups have been characterized as species, and specific epithets will be proposed in a series of publications to be submitted within the next three months. Five other new groups will be described; although these are presumably species, they will not be named. These results will permit accurate species-level identifications of mollicutes causing plant disease or proposed for use as biocontrol agents. Classification of the class *Mollicutes* was revised to conform with molecular phylogenetic data. A new order, *Entomoplasmatales*, and two new genera, *Entomoplasma* and *Mesoplasma*, were proposed. A new sterol test was devised for entomoplasmas and mesoplasmas. (2) Temperature ranges and optima of more than 50 spiroplasma species were determined by a new method involving timing of logistic organismal growth. Specialist organisms grew more slowly and had narrower temperature ranges than generalists. Tabanid spiroplasmas were used as models for study of ecological maintenance of mollicutes. Seven tabanid species have been studied extensively, and hundreds of isolates from these species have been typed to group and serovar. The results will be analyzed by collaborators, in conjunction with laboratory evidence of host/mollicute dynamics, to ascertain the role of alternate reservoir insects, geographical region, phenological constraints, and intertabanid microbial transmissions in occurrence of these agents. The results will be an important part of any effort to use mollicutes for insect biocontrol. (3) More than 300 isolates of spiroplasmas from horse flies and deer flies (tabanids) were serotyped. Analysis of the data with respect to tabanid species and geographical location showed differing degrees of host specialization of the mollicutes; some spiroplasma species, presumably as a result of geographic limitation of their hosts, showed discrete geographic distributions. Some tabanids could be infected with spiroplasmas in the laboratory, permitting study of the host-mollicute relationship. (4) Deltocephaline leafhoppers ("delts"), many of which are plant disease vectors, were studied by molecular phylogenetic means; mitochondrial and nuclear genes were used to demonstrate that delts with linear connectives fused with the aedeagus are essentially monophyletic. Molecular analyses of *Flexamia* using two mtDNA genes indicated that speciation events in this genus are due to both host transfer and vicariance. Some clades speciated almost entirely by non-host-transfer events. Sister species tended to have similar host relationships and ecologies;

more distantly related species showed more distant ecological relationships. (5) Species richness of leafhoppers in North American grasslands could be attributed to climatic partitioning of the ranges of dominant host grass species, strongly implicating phenology as a major driving force in the ecology of grassland sap-sucking insects. Photoperiod and phenology may interact to limit leafhopper occurrence in nature. (6) Principles of leafhopper ecology were applied to the BARC sustainable agriculture (SA) initiative. Transects were sampled biweekly by vacuum collection of 32 fields representing all major noncanopied habitats of BARC, with special emphasis on a 40-acre field chosen for intensive SA study. Also, the leafhopper fauna of dominant and subdominant grasses and forbs were sampled, and open-field leafhopper movement was assessed by Malaise trap sampling. The sampling will establish a data base for distribution of pest and nonpest leafhoppers on a landscape level, with respect to crop and noncrop hosts.

## 2. CURRICULUM VITAE

**Educational History**
Ph.D., Plant Pathology, University of Illinois, 1961.
M.S., Entomology, University of Illinois, Urbana, 1958.
B.A., Chemistry, Blackburn College, Carlinville, Illinois, 1953.

**Postgraduate Employment History**
1996-present Research Entomologist, USDA, Vegetable Laboratory, Beltsville, MD.
1987-96 Research Entomologist, USDA, Insect Biocontrol Laboratory, Beltsville, MD.
1971-87 Research Entomologist, USDA, Insect Pathology Laboratory, Beltsville, MD.
1966-71 Research Entomologist, USDA, Entomology Research Division, Beltsville, MD.
1961-66 Research Associate, Dept. Entomology, Univ. Calif., Berkeley, California.

**Society Offices Held**
1970 Secretary, Entomological Society of America,
Subsection C - Insects in Relation to Plant Disease.
1971 Vice Chairman, Entomological Society of America,
Subsection C - Insects in Relation to Plant Disease.
1976-78 Board of Directors, International Organization for Mycoplasmology.
1976-92 Secretary, International Subcommittee for Taxonomy of *Mollicutes*.
1978 Vice Chairperson, Working Group on Spiroplasmas, International Subcommittee for Taxonomy of *Mycoplasmatales*.
1992-96 Chairman, International Subcommittee for Taxonomy of *Mollicutes*.

**Editorial Board Appointments**
1966-68 Editorial Board, Virology.
1985-present Editorial Board, Advances in Vector-Host-Disease Relationships.

**Advisory Appointments**
1973-85 Member, International Council on Lethal Yellowing.

1975 Organizing Committee, International Organization for Mycoplasmology.
1975 Nominating Committee, International Organization for Mycoplasmology.
1976 Election Committee, International Organization for Mycoplasmology.
1975-85 Taxonomy Committee, American Society for Microbiology.
1976-96 Member, Subcommittee on Taxonomy of *Mollicutes* (International Committee on Systematic Bacteriology).
1978-87 Chairman, Beltsville Ecology Committee.
1978 Program Committee, International Organization for Mycoplasmology, meeting, Freiburg, West Germany.
1980 Program Committee, International Organization for Mycoplasmology meeting, Custer, SD.
1980-present MDDNR Technical Advisory Board for Seton Belt Woods. 1982-96 Board Member, International Research Programme on Comparative Mycoplasmology.
1982-96 Member, IRPCM Spiroplasma Working Team.
1982 Subchair for ARS Strategic Plan Approach Element: Transmission of Plant Diseases by Insects.
1984-96 Member, IRPCM MLO Working Team.
1984 Faculty, IOM Techniques Course, Bordeaux, France.
1984-88 Program Committee, International Organization for Mycoplasmology.
1984-88 Awards Committee, International Organization for Mycoplasmology.
1985 Adviser to Sasaki Associates in remapping of BARC fields.
1985-present Adviser to Maryland Heritage Program.
1988-94 American Type Culture Collection MLO Advisory Board.

**Honors and Awards**

1976 USDA Outstanding Performance Award.
1981 Science Citation Classic, Current Contents.
1982 BARD grant "Studies on nutrition, physiology, and molecular genetics of spiroplasmas: diagnosis and pathogenesis," with S. Razin and S. Rottem.
1983 ASM Foundation for Microbiology lecturer.
1985 Award, BARC remapping ($1,000).
1985 BARD grant: "Mollicutes that cause plant disease: Detection, cultivation, and physiology," with S. Rottem, T.A. Chen, and C. J. Chang.
1987 USDA-CG grant: "Cultivation and detection of mycoplasmalike organisms," with T.A. Chen, C. J. Chang, and K. J. Hackett.
1989-93 Potato Fund Grants: "Construction of a novel toxin delivery system for insect control," with K. Hackett.
1991 USDA Outstanding Performance Award, $1,000.
1993-95 NSF grant with W. Black, CSU, Ft. Collins CO, "Molecular phylogeny of Deltocephaline leafhoppers."
1994 Recipient of Emmy Klieneberger Nobel award for career achievement with International Organization of Mycoplasmology.
1995 Fellow of American Association for Advancement of Science.

## 3. LIST OF PUBLICATIONS (1993-1996)

**Peer Reviewed Publications**

1. Tully, J. G., J. M. Bové, F. Laigret, and R. F. Whitcomb. 1993. Revised taxonomy of the class *Mollicutes*: Proposed elevation of a major cluster of arthropod-associated mollicutes to ordinal rank (*Entomoplasmatales*, ord. nov.), with provision for familial rank to separate species with non-helical morphology (*Entomoplasmataceae*), from helical species (*Spiroplasmataceae*), and emended descriptions of the order *Mycoplasmatales*, family *Mycoplasmataceae*. Int. J. Syst. Bacteriol. 43:378-385.
2. Whitcomb, R.F., and A.L. Hicks. 1993. *Flexarida chaotica*, new genus and species of cicadellid from the American Southwest. Proc. Entomol. Soc. Wash.
3. Hicks, A.L., and R.F. Whitcomb. 1993. The genus *Laevicephalus* (Homoptera: Cicadellidae): hosts, biogeography, and three new species. Proc. Entomol. Soc. Wash. 95:481-487.
4. Gasparich, G., K.J. Hackett, E.A. Clark, J. Renaudin, and R.F. Whitcomb. 1993. Occurrence of extrachromosomal deoxyribonucleic acids in spiroplasmas associated with plants, insects, and ticks. Plasmid 29:81-93.
5. Hackett, K.J., R.F. Whitcomb, T.B. Clark, M. Konai, et al. *1993. Spiroplasma insolitum* sp. nov., a new species of group I spiroplasma with an unusual base composition. Int. J. Syst.Bacteriol. 43:272-277.
6. Gasparich, G., R.F. Whitcomb, F.E. French, E.A. Clark, and J.G. Tully. 1993. Serologic and genomic relatedness of group VIII and group XVII spiroplasmas and subdivision of spiroplasma group VIII into subgroups. Int. J. Syst.Bacteriol. 43:338-341.
7. Abalain-Colloc, M.L., D.L. Williamson, P. Carle, J.H. Abalain, F. Bonnet, J.G. Tully, M. Konai, R.F. Whitcomb, J.M. Bové, and C. Chastel. 1993. Division of group XVI spiroplasmas into subgroups. Int. J. Syst. Bacteriol. 43:342-346.
8. Whitcomb, R.F., J.G. Tully, D.L. Rose, P. Carle, J.M. Bové, R.B. Henegar, T.B. Clark, K.J. Hackett, M. Konai, J. Adams, and D.L. Williamson. 1993. *Spiroplasma monobiae* sp.nov., a new spiroplasma from the vespid wasp *Monobia quadridens* (Hymenoptera:Vespidae). Int. J. Syst. Bacteriol.43:256-260.
9. Whitcomb, R.F., J.C. Vignault, J.G. Tully, D.L. Rose, P. Carle, J.M. Bové, K.J. Hackett, R.B. Henegar, M. Konai, and D.L.Williamson. 1993. *Spiroplasma clarkii*, a new spiroplasma from the Green June Beetle, *Cotinus nitida* (Coleoptera: Scarabaeidae). Int. J. Syst. Bacteriol. 43:261-265.
10. Whitcomb, R.F., C. Chastel, M. Abalain-Colloc, G. Stevens, J.G. Tully, D.L. Rose, J.M. Bové, R.B. Henegar, K.J. Hackett, T.B. Clark, D.L. Williamson. 1993. *Spiroplasma cantharicola*, a new species from cantharid beetles. Int. J.Syst. Bacteriol. 43:421-424.
11. Rose, D.L., J.G. Tully, J.M. Bové, and R. F Whitcomb. 1993. A modified test for measuring sterol requirement of mollicutes. Int. J. Syst. Bacteriol. 43:527-532.
12. Fang, Q., W.C. IV, Black, H.D. Blocker, and R.F. Whitcomb. 1993. A phylogeny of New World *Deltocephalus*-like leafhopper (Homoptera:Cicadellidae) genera based on mitochondrial 16S ribosomal DNA sequences. Mol. Phylogen. Evol. 2:119-131.
13. Whitcomb, R.F., A.L. Hicks, and H.D. Blocker. 1994. Biogeography of leafhopper specialists of the shortgrass prairie: Evidence for the roles of phenology and phylogeny in determination of biological diversity. Am. Entomol. 40:19-35.

14. Whitcomb, R.F. 1994. North American grasslands as insect habitat: a photographic essay. Am. Entomol. 40:93-101.
15. Hiss, R.H., D.E. Norris, C.R. Dietrich, R.F. Whitcomb, D.F. West, C.F. Bosio, S. Kambhampati, J. Piesman, M.F. Antolin, and C.W. IV Black. 1994. Molecular taxonomy using single strand conformation polymorphism (SSCP) analysis of mitochondrial ribosomal DNA genes. Insect Mol. Biol. 3:171-182.
16. Tully, J.G., R.F. Whitcomb, D.L. Rose, J.M. Bové, P. Carle, N.L. Somerson, D.L. Williamson, and S. Eden-Green. 1994. *Acholeplasma brassicae* sp. nov., and *Acholeplasma palmae* sp. nov., two sterol-nonrequiring mollicutes from plant surfaces. Int. J. Syst. Bacteriol. 44:680-684.
17. Tully, J.G., R.F. Whitcomb, K.J. Hackett, D.L. Rose, R.B. Henegar, J.M. Bové, P. Carle, D.L. Williamson, and T.B. Clark. 1994. Taxonomic descriptions of eight new sterol nonrequiring mollicutes assigned to the genus *Mesoplasma*. Int. J. Syst. Bacteriol. 44:685-693.
18. Konai, M., R.F. Whitcomb, and M. Camp. 1994. Growth of spiroplasmas at the upper temperature range limit. IOM Lett. 3:527-528.
19. Whitcomb, R.F. Systematics of prokaryotes and eukaryotes: 1994. A search for a synthesis. IOM Lett. 3:1-7.
20. Wedincamp, J., F.E. French, N.E. Deal, A.J. Lecroy, B.A. Hester, F.V. Vencl, R.B. Henegar, J.G. Tully, and R.F. Whitcomb. 1994. Laboratory transfer of *Spiroplasma* among tabanid flies and firefly beetles. IOM Lett. 3:533-534.
21. Bové, J.M., P. Carle, J.G.Tully, R.F. Whitcomb, and F. Laigret. 1994. Sterol nonrequiring spiroplasmas: Do they deserve a new genus? IOM Lett. 3:449-450.
22. French, F. E., J. Wedincamp, J.M. Harper-Punjab, J.C. Gravitt, R.B. Henegar, and R.F. Whitcomb. 1994. Laboratory infection of Tabanidae (Diptera) with tabanid associated *Spiroplasma* and carriage in *Tenebrio* (Coleoptera) and *Sarcophaga* (Diptera). IOM Lett. 3:453-454.
23. Konai, M., R.F. Whitcomb, J.G. Tully, D.L. Rose, P. Carle, J.M. Bové, R.B. Henegar, K.J. Hackett, T.B. Clark, E.A. Clark, and D.L. Williamson.1995. *Spiroplasma velocicrescens*, a new species from the vespid wasp *Monobia quadridens.* Int. J. Syst. Bacteriol. 45:203-206.
24. Tully, J.G., D.L. Rose, C.E. Yunker, P. Carle, J.M. Bové, D.L. Williamson, and R.F. Whitcomb. 1995. *Spiroplasma ixodetis* sp. nov, a new species from *Ixodes pacificus* ticks collected in Oregon. Int. J. Syst. Bacteriol. 45:23-28.
25. Whitcomb, R.F., J.G. Tully, J.M. Bové, J.M. Bradbury, G. Christiansen, I. Kahane, B.C. Kirkpatrick, F. Laigret, R.H. Leach, H.C. Neimark, J.D. Pollack, S. Razin, B.B. Sears, and D. Taylor-Robinson. 1995. Revised minimum standards for description of new species of the class *Mollicutes* (division *Tenericutes*). Int. J. Syst. Bacteriol. 45:605-612.
26. Hicks, A.L., and R.F. Whitcomb. 1996. Notes on the leafhopper (Homoptera: Cicadellidae) fauna of southeastern New Mexico grasslands, with emphasis on gypsum grasslands and description of a new species of *Athysanella* (Cicadellidae: Deltoceph-alinae). Proc. Entomol. Soc. Wash. 145-157.
27. Whitcomb, R.F., G. Gasparich, F.E. French, J.G.Tully, D.L. Rose, P. Carle, J.M. Bové, R.B. Henegar, M. Konai, K.J. Hackett, J. Adams, T.B. Clark, and D.L. Williamson. *Spiroplasma syrphidicola*, sp. nov., from syrphid flies. Int. J. Syst. Bacteriol. (In press)

28. Konai, M., E.A. Clark, A.L. Koch, and R.F. Whitcomb. Temperature requirements of spiroplasmas. Curr. Microbiol. 32:1-7.
29. Wedincamp, J., F.E. French, R.F. Whitcomb, and R.B. Henegar. Spiroplasmas and entomoplasmas (Procaryotae: Mollicutes) associated with fireflies (Lampyridae:Coleoptera) and Tabanids (Diptera: Tabanidae). J. Invertebr. Pathol. (In press).
30. Hackett, K.J., R.F. Whitcomb, T.B. Clark, R.B. Henegar, D.E. Lynn, A.G. Wagner, J.G. Tully, G.E. Gasparich, D.L. Rose, P. Carle, J.M. Bové, M. Konai, E.A. Clark, J.R. Adams, and D.L. Williamson. *Spiroplasma leptinotarsae*, from the Colorado potato beetle *Spiroplasma decemlineata*. Int. J. Syst. Bacteriol. (submitted).
31. Carle, P., R.F. Whitcomb, K.J. Hackett, J.G. Tully, J.M. Bové, R.B. Henegar, M. Konai, and D.L. Williamson. *Spiroplasma diabroticae* sp. nov., from the Southern Corn Rootworm Beetle *Diabrotica undecimpunctata* (Coleoptera: Chrysomelidae). Int. J. Syst. Bacteriol. (submitted).
32. Stevens, C., A.Y. Tang, E. Jenkins, R.L. Goins, J.G. Tully, D.L. Rose, M. Konai, D.L. Williamson, P. Carle, J.M. Bové, R.B. Henegar, K.J. Hackett, F.E. French, and R.F. Whitcomb. *Spiroplasma lampyridicola* sp. nov., from the firefly beetle *Photuris pennsylvanicus*. Int. J. Syst. Bacteriol. (submitted).
33. Hackett, K.J., E.A. Clark, R.F. Whitcomb, and J.G. Tully. Amended data on arginine utilization by *Spiroplasma* species. Int. J. Syst. Bacteriol. (submitted).
34. Williamson, D.L., J.G. Tully, L. Rosen, D.L. Rose, R.F. Whitcomb, M.L. Abalain-Colloc, P. Carle, J.M. Bové, and J. Smyth. *Spiroplasma diminutum* sp. nov., from *Culex annulus* mosquitoes. Int. J. Syst. Bacteriol. (In press).
35. Hackett, K.J., R.F. Whitcomb, F.E. French, J.G. Tully, G.E. Gasparich, D.L. Rose, P. Carle, J.M. Bové, R.B. Henegar, T.B. Clark, M. Konai, E.A. Clark, and D.L. Williamson. *Spiroplasma corrusci*, sp. nov., a new species from a firefly beetle (Coleoptera: Lampyridae) and tabanid flies (Diptera: Tabanidae)
36. Dietrich, C., W.C. Black, and R.F. Whitcomb. Molecular phylogenetics and the evolution of host associations in the grassland leafhopper genus *Flexamia* (Homoptera:Cicadellidae). Evolution (submitted).

**OTHER SIGNIFICANT PUBLICATIONS**

1. Hackett, K.J., and R.F. Whitcomb. Cultivation of spiroplasmas and defined media. Molecular and Diagnostic Procedures in Mycoplasmology Volume I (S. Razin & J. G.Tully eds). Academic Press, New York. pp. 41-54. 1995.
2. Whitcomb, R.F., and K.J. Hackett. Identification of mollicutes from insects. *In* Molecular and Diagnostic Procedures in Mycoplasmology. Volume II (J.G. Tully & S. Razin eds). Academic Press, New York. pp. 313-322. 1995.
3. Tully, J.G., and Whitcomb, R.F. Minimal standards for description of new species of the class *Mollicutes*. Methods Mycoplasmol. Volume II. (S. Razin & J. G. Tully eds). Academic Press, New York. pp. 339-347. 1996.
4. Saillard, C., Barthe, C., Bové, J.M., and Whitcomb, R.F. Diagnosis of *Spiroplasma* infections in plants and insects. Molecular and Diagnostic Procedures in Mycoplasmology. Volume II (S. Razin & J.G. Tully eds). Academic Press, New York. pp. 293-297. 1996.

5. Foissac, X., Danet, J.L., Saillard, C., Whitcomb, R.F., and Bové, J.M. Experimental spiroplasma infections in plants and insects. Molecular and Diagnostic Procedures in Mycoplasmology. Volume II (S. Razin & J.G. Tully eds). Academic Press, New York. pp. 385-389. 1996.

**Linkages with Other Laboratories:**

Drs. **T. A. Chen and Y. H. Guo**. Rutgers University, Dept. Plant Pathology. Mycoplasmalike organism of New Jersey aster yellows.

Dr. **C.-J. Chang**. U. Georgia, Griffin, Dept. Plant Pathol. Attempted cultivation of mycoplasmalike organisms.

Dr. **J. G. Tully, D. Rose**. NIH, NIAID, Frederick MD, Taxonomic description of spiroplasmas, entomoplasmas, and mesoplasmas; serology, biochemical characterization of mollicutes

Drs. **J. M. Bove, C. Saillard, J. Renaudin, F. Laigret, P. Carle, M. Garnier, J. C. Vignault, and M. Bonnet**. INRA, Bordeaux, France. Genomic characterization of mollicutes; genome size, guanosine + cytosine content of DNA, DNA/DNA hybridization.

Dr. **D. L. Williamson and D. Colflesh**. SUNY, Stony Brook. Electron microscopy, cell biology, serological analysis, and characterization of mollicutes.

Drs. **C. Chastel and M. Abalain-Colloc**. Faculte de Medecine, Brest, France. Characterization of spiroplasmas.

Dr. **C. Stevens**. Tuskegee University, Dept. Biology. Characterization of beetle spiroplasmas.

Dr. **H. D. Blocker**. Kansas State University, Dept. Entomology. Leafhopper taxonomy and cladistics.

Drs. **W. Black, Q. Fang, C**. Dietrich. Colorado State University, Ft. Collins, Dept. Microbiology. Molecular phylogeny of leafhoppers.

Drs. **F. E. French, D. V. Hagan and J. A. Rafter; J. Wedincamp and R. Mulder**. Georgia So. U., Statesboro. Tabanid spiroplasmas.

Dr. **K. G. A. Hamilton**. Agriculture Canada, Ottawa. Taxonomy and ecology of leafhoppers.

**J. Krouse**. University of Maryland. Sustainable meadows.

**K. J. Hackett, D. E. Lynn, J. R. Adams**. Insect Biocontrol Laboratory, ARS, BARC. Spiroplasma and phytoplasma research, database design.

**R. Spjut**. Systematic Mycology and Botany Laboratory, ARS, BARC. Plant species richness of sustainable meadows.

**L. R. Benedict**. Farm Operations Branch, BARC. Design, analysis, and maintenance of sustainable meadows.

**J. Feely**. U. S. National Arboretum. Sustainable meadows.

**J. Englert**. SCS Plant Materials Center. Propagation of seedlings, selection of ecotypes for eastern meadows.